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Channeling Massachusetts' Future
in a New Innovative Direction...

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Science & Technology

A TASK FORCE REPORT

*Using Science & Technology to create an
Economic Engine for the Commonwealth*

Presented by: Representative Mark A. Howland

Photos Courtesy of Tim Slyvia - Commercial Photographer
www.timslyvia.com

Preface

This task force report highlights the role of science and technology in Massachusetts's future, draws upon the innovation in our past, and focuses on the strategic assets that can form the basis for continued progress and development.



It begins with an Introduction by Representative Mark A. Howland, D-Freetown for this presentation titled:

PHOTO NOTE: A child examines an Azorean whaleboat at the New Bedford Whaling Museum, a craft considered the finest example of task-specific design by craftsmen for a specific purpose – 19th century whaling.

"Using Science and Technology to Create an Economic Engine for the Commonwealth."

Representative Howland, who also is the CEO of a company who won the nation's only back-to-back EPA awards for environmental technology in 1998/99, and was a 2001 EPA Environmental Merit Award winner as well, starts this special task force report highlighting the roadblocks and stumbling blocks that restrict high-tech, bio-tech, science-tech, and other innovative companies from advancing in Massachusetts.

It is followed by a Forward by Representative Brian S. Dempsey, Chairman of the House Committee on Science and Technology who, as one of his first tasks as Chairman, placed special importance on science and technologies initiatives at the forefront of a progressive strategy to assist Massachusetts in remaining a leader in a field cited as the vital economic engine for Massachusetts future.

The task force report will have a commentary on the need for productivity, science, and technology in the lives of Massachusetts's citizens. The underlying rationale for Massachusetts' movement toward a technologically driven growth strategy is set forth. The assets and status of industries that provide growth and contribution to economic and human development is assessed and summarized for action points.

This report contains a short summary of some of the key assets and resources that have formed the basis for Massachusetts' progress in science and technology endeavors. These in turn, point to additional areas and potentials for science and technology to create an economic engine for Massachusetts, for further growth for the Commonwealth, and for success and prosperity for our state's firms and employees. As can be seen, and perhaps inadvertently excluded, various Massachusetts-based enterprises, and governmental programs are already actively developing or pursuing these potentials. However, as this report is a work in progress, inclusion of specific programs or activities does not imply state endorsement or lack thereof.

**Using Science and Technology to create
An Economic Engine for the Commonwealth**

Introduction – State Representative Mark A. Howland

“It is time to channel Massachusetts’ future into a new innovative direction,” states Representative Howland, D-Freetown, who represents the fast growing Southeastern Massachusetts region. “We need to focus on the strategic assets we have, and use them to form a basis for continued progress and development.”



Representative Mark A. Howland
Task force author – Science and Technology

This task force report, intended only as an informational document, attempts to highlight and expose the emerging economic engine of Massachusetts – science-based technologies. Already a leader in the future of our state, this task force report is offered to recognize the assets the industry offers, examine the roadblocks and stumbling blocks preventing the industry from advancing, and citing recommendations, solutions, and ideas to form a concise plan, and government-recognized agenda to assist job creation, quality of life, viability, and economic vitality.

Examples will be used throughout this document. There is no intent to highlight any firms, any Massachusetts agency, or any company’s innovation. Examples cited, whether they be a state agency or private firm, or noted product; are not to be considered an endorsement or critique. I purely offer these examples for the intent purpose of awareness, for an overall observation of the impediments, advantages, or for highlighting the human capital that drives technological progress. A special focus on the roadblocks and stumbling blocks that impede the economic engine that creates a future for Massachusetts is offered.

Let’s look ahead... we have a wonderful climate for scientific inquiry, for technological advancement and application, for our quality of life. Let’s take the tools we have in the science-driven industries, let’s remove the roadblocks for advancement, and let’s drive forward for prosperity and health. I hope you enjoy our brief foray into our future...

It is essential that the Commonwealth continue to expand and improve the scope of technology-driven efforts. We need to recognize the innovation within our state, work as a partnership with industry and universities, and play into our strengths and reduce our weakness. I ask that you join me in exploring the ways to create an economic engine for the Commonwealth, to create jobs for our citizens, to improve our quality of life. I ask for your help, your patience, and your assistance. ”

State Representative Mark A. Howland

**Using Science and Technology to create
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“The role of science and technology in Massachusetts’ economic future needs to be highlighted,” is the statement of Chairman Brian S. Dempsey, D-Haverhill. “This task force presentation is the first of a series of actions and recommendations to assist legislative, business, academic, and citizen leaders in solidifying Massachusetts’ role in the science and technology industries.

Massachusetts is at a crossroads, constrained fiscal resources, escalating costs, and competing social priorities are forcing us to make hard, but essential decisions that will eventually bring about difficult trade-offs between social versus economic benefits. To improve our revenue and income-generating capabilities, Massachusetts sees great potential in science and technology, which can be leveraged to national and worldwide levels to attract further investment to the Commonwealth’s economy.

Here in Massachusetts, we serve as one of the United States’ primary leaders in research and development efforts, especially in the fields of biotechnology, aquatic resources, information technology (IT), telecommunications, software development, energy innovation, and other technology-based industries.

Our research and science prowess has not gone unnoticed in both national and international forums. For example, our educational system, highlighted by the medical acumen acknowledged for Boston hospitals, the computer-related firms found along the Route 128 and Route 495 interchanges that circle Boston, or the specialized technologies found in every region, district, city, and town of Massachusetts have far-reaching implications, and form the basis for media stories of “incredible achievements” for many of our firms and their developments. Whether it is golf balls manufactured by Titleist in New Bedford, custom police scanning software by Cerulean Technology in Marlboro, computer-driven plastic moldings by Custom Extrusions in Sheffield, high performance engineered polyolefin foams manufactured by Sentinel Polyolefins of Hyannis, ebusiness applications by the Exeter Group of Cambridge, stem cell bio-technology by Viacell of Boston, disposable electrodes by Medtronics of Haverhill, or any other of the special firms which provide for our quality of life, our economy, and our future; Massachusetts wants to demonstrate our commitment to science and technology.

Join me in exploring the Massachusetts’ climate conducive to scientific inquiry and technological application.

Representative Brian S. Dempsey, House Science and Technology Committee Chairman

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Figure 1 - Schaefer Marine of New Bedford is a world leader in technological gear for the fishing, marine, sport fishing, and sailing industries. A picture of their popular JamCleat exhibits graphically a way to channel our future in to a New Direction.

The Need for Productivity, Science, and Technology in Our Lives

As Chairman Brian Dempsey so clearly and succinctly indicated in his foreword to this presentation, Massachusetts possesses unique assets, including natural resources from our seashores off Cape Cod to our beautiful rolling hills and mountains in the Berkshires; as well as state-of-the-art communications, technologically-oriented higher venues of education, manufacturers who lead the world in innovation and productivity, and citizens who wholeheartedly understand the need and role of science and technology in our lives.

As the Representative from the 12th Bristol District in Southeastern Massachusetts – a district sometimes known as the “SouthCoast”. Mark Howland has a personal understanding

of the role of science and technology from his professional and business background. Massachusetts is the leader in innovation and technological change, and the region Representative Howland represents joins the rest of the Commonwealth in leading the way to contribute meaningfully to economic growth and rising living standards with our special creativity and ingenuity. As it is commonly said in the SouthCoast region Representative Howland hails from; “if necessity is the mother of inventions, then surely Yankee ingenuity is the father.”

Here in Massachusetts, we have assets that need to be unlocked. The focus on the endeavor to use science and technology to make meaningful changes in our economic viability, significant contribution to our lifestyles, and impact to our quality of life requires that we consider using technological change and innovation to our benefit.

How can we focus on technological change and innovation?

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It is needed to regard Science and Technology as a vanguard for the future. The development of new ideas that produce products that change our lives requires respect. The productivity of those products to produce more efficiently requires support. Enhanced and expanded education and training lends new knowledge throughout the economy.

Sustainable growth can come only from utilizing technological innovations that produce real gain in efficiency, real gains in quality of life, real gains in employment and subsequent revenue, and real gains in channeling our future to a new direction.

Where can we start as a Commonwealth?

We should regard two basic strategies:

1/ - attract new technologies and support current technologies that support or diversify our economic strengths. New technologies provide a nucleus for new economic activity. Existing technologies are too often shuffled to the side in favor of the “current flavor of the day”, media promotions, slick marketing tactics.... Recognition of new and current technologies with real and significant impact to lifestyles, to employment, to technological advances, to potential or actual investment and subsequent job growth need to be a priority.

At this time in the Commonwealth of Massachusetts, there is no greater challenge than to maintain, recognize, enhance, and promote the growth momentum of the science and technology industries. Science related jobs, excluding those related to internet and computer technologies, and focusing on those related to environmental, ecological, biological, and health related sciences – accounted for 4 out of every 10 newly created jobs in the period from 1990-2000. Only the computer related technologies (5 out of every 10 jobs created) surpassed the potential of science-related industry as a job-creator.

Massachusetts needs to realize that we face stern competition because of the global advance of technology and the knowledge that it transmits throughout the world. We need to understand that technology development cannot mature in isolation, it cannot mature being sourced in Massachusetts, and it cannot mature without support. Competition requires recognition and respect for emerging technologies; it requires support for developing technologies and initial entry to marketplaces, and it requires governmental, institutional, and educational support to the endeavors and contributors to realize success. We need to employ new technology and new knowledge to enhance and diversify our offerings.

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2/ - secondly, the vision of Massachusetts' future requires an investment in the future. There is a need for the recognition that it is essentially human capital that drives scientific progress. We need to play to our strengths, support technological progress, utilize our high-technological centers throughout the state, support expenditures by institutes and firms for research and development, marketing, product introduction, and lifestyle entry in order to pursue a future.

Beyond recognition, there is a need for commitment. We need a commitment to education and training, to respect of intellectual property, to a realization of blending common sense with economic vitality.

And there is a need to expand and improve the scope of technology-related efforts. The tools are here in the Commonwealth. We have the industry/government/education institution partnerships; we have the status worldwide for innovation and boldness. We have the students, the employees, and the personnel that are not inhibited by a science and technology subject matter. It is time to use our assets, to unlock the barriers that restrict our growth, to offer support and development for the various areas in which Massachusetts can excel.

It is the role of State Government with the Private Sector to help link these products and processes - from the world of research, from the world of academia, from the world of business, and yes, from the world of government; to take the potentials of the scientific commercial world, and bring them forward to make a difference in our lives.

Although the economic challenges we face as a Commonwealth are many at this time, although we have competitors in our race for technological support, and although our sagging economy restricts our aid; the Massachusetts assets and industry support cannot be undervalued. I am optimistic about the talents in this Commonwealth, about our ability to use science and technology to create a new economic engine for Massachusetts, and to channel our future in a new direction.

I trust we have the ability and commitment to make the basic changes to solve these problems, to recognize our advantages and detriments, and to make choices. I trust in our Massachusetts Government, my Fellow Legislators, and the People of the Commonwealth of Massachusetts to make a difference.

State Representative Mark A. Howland
12th Bristol District – Freetown, New Bedford, Lakeville, Middleboro, and East Taunton

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Attachment – the House Science and Technology Caucus Resolve

RELATIVE TO THE ADOPTION OF A COMPREHENSIVE PUBLIC POLICY AND STRATEGY FOR THE PRESERVATION AND ADVANCEMENT OF SCIENCE AND TECHNOLOGY BASED ECONOMIC DEVELOPMENT THROUGHOUT THE COMMONWEALTH.

Whereas, The health of the Massachusetts economy has long been associated with innovation in business practices and the commercial application of emerging technologies; and

Whereas, Competition from other regions and states threatens to undermine the commonwealth's traditional leadership in technology and knowledge creation which is a product of some of the Commonwealth's greatest assets: its universities, hospitals, laboratories, and research and development facilities; and

Whereas, The continued vitality of this science and technology dependent economy requires a highly skilled, flexible workforce educated in science, mathematics and technology; and

Whereas, Public kindergarten through grade twelve education institutions struggle to keep pace with the rapidly expanding and changing body of knowledge in science and technology and must draw on all resources available to the commonwealth particularly those present in science and technology based industries; and

Whereas, The percentage of students graduating from high school in Massachusetts with the intention of pursuing an education in science, engineering, technology or mathematics is extremely low for the natural demand that exists in the commonwealth; and

Whereas, The commonwealth desires to support and leverage the role of private research universities, colleges and teaching hospitals in the development and transfer of knowledge to the state's economy; and

Whereas, The commonwealth desires to have a comprehensive investment strategy for facilities to support research in the public university system; and

Whereas, The commonwealth desires to leverage the infrastructure of the public university, state college, and community college systems and leading private institutions to encourage the development of a culture of entrepreneurship, innovation, and life-long learning throughout the state; and

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Whereas, The commonwealth desires to encourage the formation of and facilitate access to capital, including seed and working capital, throughout the state for science and technology based economic development; and

Whereas, The commonwealth desires to support entrepreneurial activity and local initiatives among under-represented populations throughout the state; and

Whereas, Advances in electronic communications and record-keeping offer new accessibility and efficiencies that benefit all commonwealth citizens and businesses, especially its science and technology industries, but pose new challenges to privacy and transactional certainty; and

Whereas, E-Government affords substantial advantages for citizens, businesses, and government by allowing citizens and businesses to conduct their affairs with the Commonwealth on-line, saving them time and money; improving access to government services; and reducing transaction costs. E-Government also enhances the efficiency and effectiveness of government services; and

Whereas, the commonwealth desires to lead through the continuing development of its scientific and technological assets guided by its traditional values of entrepreneurship and fairness; now therefore be it

Resolved, That it shall be the policy of the commonwealth to support the preservation and advancement of science and technology based economic development with a statewide strategy; and be it further

Resolved, That the strategy addresses the commonwealth's public and private education system and advances science and technology based economic development by ensuring that the system:

Fosters and facilitates collaborations among public and private institutions of higher education, and between those institutions and private industry, and to promote scientific research and the utilization of Massachusetts research done by Massachusetts based companies; and

Supports regional and statewide collaborations including but not limited to the creation of centers of excellence and university consortia activity, funded with federal and private funds that are matched by existing state funds. Existing state funds used for similar or related activities should be made available to these efforts; and

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Utilizes the resources of the entire public education system, i.e., the kindergarten through grade twelve school systems, community colleges, state colleges, the University of Massachusetts system, and the private institutes of higher education and community based continuing education programs, to enhance the Massachusetts workforce, including underrepresented populations, for the science and technology industry sectors; and

Significantly increases effective training for teachers and administrators in mathematics, science and technology; and

Coordinates partnerships between industry and the kindergarten through grade twelve school systems to increase their capacity to teach mathematics, science and technology, and involves the students themselves in improving their school's capacity in these areas; and be it further

Resolved, That the strategy address the need to nurture existing technology companies and assist entrepreneurs in creating new companies and in doing so may include helpful services such as:

A structure to provide business and technical assistance to technology entrepreneurs and firms including preparation of business plans, setting up acceptable accounting practices, creating fundable credit profiles, and developing commercialization strategies and market evaluation; and

A marketing effort to increase awareness of these services using appropriate government entities and non-government associations such as the Massachusetts Software and Internet Council, the Massachusetts Biotechnology Council, the Massachusetts High Technology Council, Associated Industries of Massachusetts, Mass Medic, the Massachusetts E-Commerce Association, the Massachusetts Telecommunications Council, AeA, private universities and private venture capital firms; and be it further

Resolved, That the commonwealth promote a flexible and exemplary legal infrastructure to facilitate the continuing capacity to conduct business using electronic contracts, signatures and other records that is appropriately balanced among producers, users, and other stakeholders; and be it further

Resolved, That the commonwealth strives to be a leading provider of services to citizens and businesses through equitable and efficient e-government; and be it further

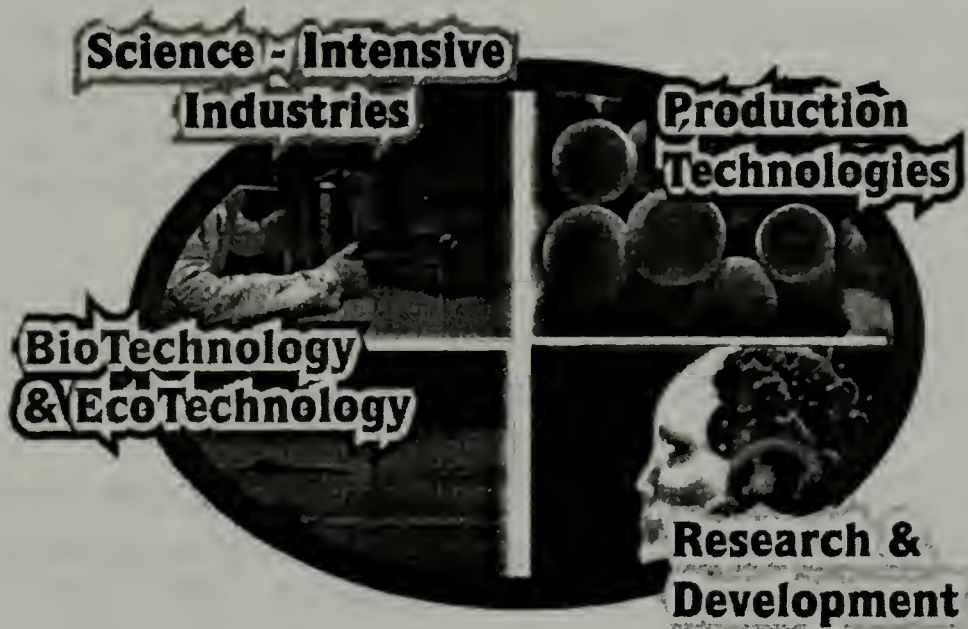
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*State Representative Mark A. Howland
12th Bristol District – Freetown, New Bedford, Lakeville, Middleboro, & East Taunton*

Resolved, That the commonwealth seeks to provide a tax and regulatory environment that is consistent and supportive of science and technology based economic development.



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Massachusetts Assets –
Leaders in Science and
Technology
Development

A Heritage of Brilliance

Since the early days of
our heritage when the
Pilgrims landed on the
shores of Plymouth;
innovation has been part

of Massachusetts' ability to compete. From the early days of Swamp Yankee ingenuity that allowed poor Pilgrims to use tools and techniques to populate a harsh land; to the working ability, improvements, and advances our immigrants brought to move Massachusetts from an agrarian society to an industrial one; to the students and Massachusetts college and university reputation for breakthroughs, scientific advances, and technological advances; Massachusetts has always been well-positioned to compete in a broad range of science and technology endeavors.

Our Assets that make us so special....

Massachusetts is the birthplace of democracy. Our state is a home to unique regions such as the Berkshires, Cape Cod, the North Shore, the South Coast, the hills of Worcester, the City of Boston, the South Shore. Even an island like Nantucket earned its own reputation as a stand-out community known around the world with whaling, coffee, business dealings, and tourism. Nantucketers were like the rest of Massachusetts communities, proud to stand alone, proud to be self-sufficient, proud of the ability of innovation and the use of science to make a better life. Even today the self-sufficient pride remains - a visitor leaving Nantucket is reminded that they are returning to America.

- Each and every one of our communities in the region is home to innovation, home to special companies making a mark in the state, in the nation, and yes, home to products and techniques recognized around the world.

Our state has a strategic location. Not only are we the mid-positioned state within the New England region, Massachusetts is the hub for entry to other regions of the nation and Europe. Boston, known so ably as the "Hub", provides a gateway to and from Europe in both directions. The state has earned a business reputation from every corner of its boundaries throughout the country, and our colleges and

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universities are considered unsurpassed. A European market lays a few air flight hours away, closer even than the West Coast of the United States, a market with a raging economy, an appreciation of technology, and a respect for American ingenuity.

- Given our state's strategic New England and East Coast location, we are ideally suited and situated to serve as a national bridge to Europe and its markets, as well as to the rest of the United States.

Only two regions of the United States are prominently noted for global information superhighways – Silicon Valley in California, and the Route 128/495 belt in Massachusetts. Research, Innovation, Development, Vision are all tools that make our state an important node on the roadway to the future. From the days when names like Wang and DEC made Massachusetts a known location, to the present day when start-ups, retrofitted companies, stalwart standbys still make our region a technological leader; Massachusetts has the reputation, the vision, the leaders, the innovators, and yes the risk-takers - to use science and technology to create a new economic engine for the Commonwealth.

- The internet, fiber, satellite and other high tech connectivity venues make Massachusetts ideally suited and a continuing important node on the worldwide information highways.

More innovation comes from Massachusetts than any other state, region, or country. Whether it is an advance in medicine, a breakthrough in communication, a detailing in computer modeling, a commitment to natural resource management, or a startling new product that changes our lives; more new products, more new services, more life-changing experiences come from the Bay State than anywhere else. From our heritage, from our educational venues, from our talents brought together; innovation is our trademark, and well-deserved reputation.

- The resources and talents of Massachusetts' citizens as innovators, educators, developers are unsurpassed. Massachusetts welcomes technological change, Massachusetts understands breakthroughs; Massachusetts supports new ideas, new concepts, and new products...

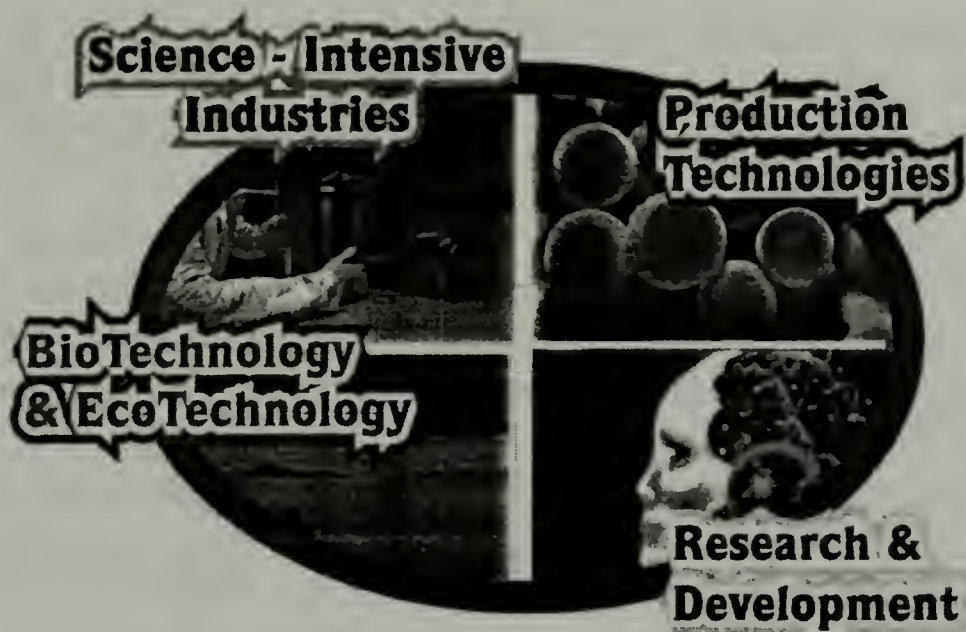
We are the home to the world's premier sites for research demonstration and development in Bio-technology, Computer Sciences, Environmental Protection, Tele-Communications, and other science-intensive industries...

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- There is a reason why firms chose Massachusetts for the start to innovation. It is not just the talents found in our colleges, it is not just the availability of resources – it is the climate, a climate for success, a climate for respect, a climate for a future....

Our state serves as a national leader for research and development efforts related to telecommunications, biotechnology, marine resources, renewable energies, and other technology based industries. Our experience and expertise in such areas as modern agriculture; marine and ocean technology and science; health and medical biotechnology; structural, mechanical, and environmental engineering; land-based geophysics; energy resource development; conservation techniques; waste management; and others are not only valuable for the development of our economic future, but for the preservation of the resources that caused us to be recognized as leaders in science and technology.

The next section provides a brief reasoning of why Massachusetts is leaders in the nation, and leaders in the world. That section is followed with a limited sampling and introductory description of sample technologies that give an example of programs, activities, successes, opportunities, and potentials for economic growth.



Massachusetts Assets –
Leaders in Science and
Technology
Development

A Heritage of Brilliance

Leaders in the nation, and
Leaders in the world is a
good description for
Massachusetts
companies.

Leaders in the Nation, Leaders in the World....

The development and application of technology is central to economic development. One needs to take into account the amount of research funding expended in Massachusetts, the volume of patents issued, the proportion of scientists and engineers in the labor force, the extent of cooperation with universities, and the relative worth of science-intensive companies to get a true measure of Massachusetts prominence in this field.

In 2001, according to the Beacon Hill Institute, Massachusetts was ranked second only to Delaware for overall competitiveness in the nation. And it is suspected that the ease of forming corporations in Delaware as part of the overall high-ranking governmental policy and fiscal policies that state enjoys, creates the slight ranking ahead of Massachusetts whose #1 top-ranking in human resources, technology, and finances was slightly weighed down by a miserable 47 out of 50 ranking in governmental policy and fiscal policies. And that low ranking in governmental policy is a primary reason for the production of this report. Identifying the roadblocks and stumbling blocks on the governmental level is a key to shifting the science and technology engine into high gear.

It is anticipated that for 2002, Massachusetts ranking will slip to 4th or 5th overall. Particular concerns are the availability of the labor pool - less entry-level professionals are entering the work force to balance the higher paid long-term professionals that are limited in numbers and expensive to round off a work force. As well, Massachusetts is seen as over-regulated, particularly in environmental regulations, making a move to productivity from research and development difficult. Additionally, utility prices, particularly electricity, form more hurdles to competitiveness. A last restricting and increasing factor is the housing market, both

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as related to the average cost of renting an apartment or purchasing a home, or to the travel time connected to finding a reasonable priced dwelling in relation to the places of employment.

Massachusetts remains highly ranked in several factors. Our crime index is reducing. Our population is technology aware with an increasing number of households having internet access. Our unemployment rate is the 4th best in the nation, though that also indicates perhaps that the work pool is limited and prevents rapid expansion of a firm in the fast-changing science industries. Our medical care is top-ranked, our college and university systems unparalleled, we have more venture capital at our disposal than any where else in the nation, and our environmental risks to the population are extremely low, perhaps in response to the strict environmental regulations.

Later on in this report, there are recommendations to the Commonwealth to channel Massachusetts' future upwards. We remain leaders, but leaders must continue to lead to maintain leadership. We can retain from this section key-noted points.

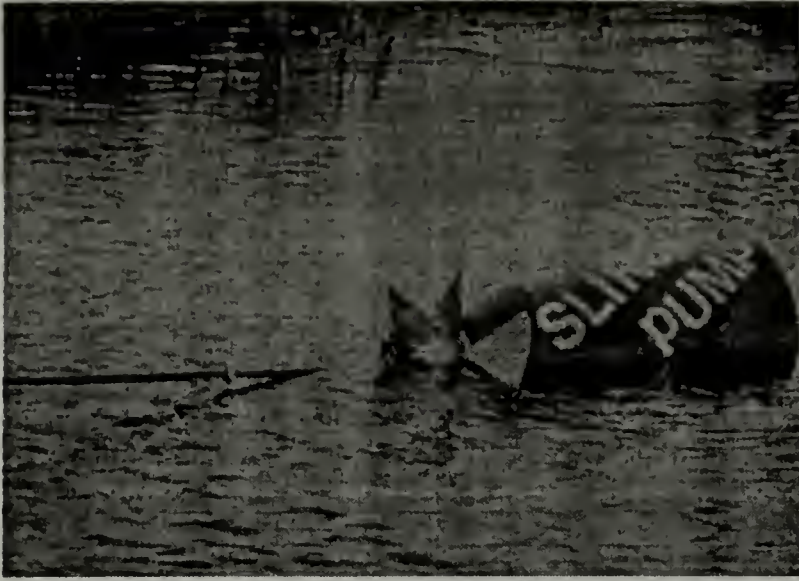
On a Plus side...

- Technological awareness
- Health Care and Education
- Trained Work Force
- Venture Capital

Negatively...

- Less entry-level professionals
- Extensive regulation
- Ancillary costs
- Cost-of-Living factors

If the Commonwealth of Massachusetts does not put an action place into place, we will continue to lose ground in our competitiveness as compared to other states, we will lose companies and scientists to other locales, nationally and internationally. Massachusetts needs to remain committed and focused on growing economic development.



The Sling Pump, shown here on the Great Cedar River in Lakeville use centrifugal action to collect water from a fast moving water flow, and pump it as far as 2 miles away and 40 feet high with one moving part and no electricity or energy costs. Photo courtesy of BioMass Farms, Lakeville, MA

Massachusetts Assets – Leaders in Science and Technology Development

Sample Technologies

This is only a brief sampling of technologies found within Massachusetts. There is no intent to highlight or exclude any firm, nor does inclusion here serve as an endorsement. This is an attempt to exemplify the leading types of technologies found here, to demonstrate the vast range of

impact on our lives, and to point out the innovation our firms build businesses on.

Science - Intensive Industries

Massachusetts is noted for its industries based on science. A brief look at the monthly Ambassador A-list of the Massachusetts Alliance for Economic

Development (www.massecon.com) shows the companies with new products and funding. As can be seen here in a recent news release, Science-Intensive Industries make up the bulk.

- NIH chooses Beverly company for DNA sequencing
Mass High Tech 7/22/02
- Medical device industry displays immunity to economic slowdown
Mass high Tech 7/22/02
- Proposed patent fee hikes would discourage innovation
Mass high Tech 7/22/02
- Banks bolster technology despite economic slump
Boston Business Journal 7/19/02
- In tech, small VC rounds here to stay
Boston Business Journal 7/19/02
- Evolving business center is changing the face of Tri-Area
Worcester Business Journal 7/1/02-7/14/02
- Making the Knowledge Corridor Part of the Local Vocabulary
Business West Online 6/02
- Midsized biotech firms take hit
Boston Globe 6/10/02
- Imaging device manufacturer moves HQ from Calif. to Woburn
Mass High Tech 6/7/02

Since our early days as a colony, science played a part of the Massachusetts economy. The first recorded business in Massachusetts was the Plymouth Rock Trout Farm, started in the mid 1600s to attempt to culture rainbow trout as a food supply rather than depend on wild-harvested stock. That firm, since in existence today in its

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Preface

Introduction by Representative Mark A. Howland

Forward: The Honorable Chairman of Science and Technology – Rep. Brian Dempsey

The Need for Productivity, Science, and Technology in Our Lives
Commentary

Massachusetts Assets – Leaders in Science and Technology Development

Our Assets that make us so special
Leaders in the Nation, Leaders in the World...
Technologies – two samples
Science-Intensive Industries
Bio-Technology and Eco-Technology

Science and Technology as an Economic Engine for Massachusetts Future

Our Heritage as Innovators and Business Incubators
The Key to Massachusetts' Economic Future
Roadblocks and Stumbling Blocks in the path to the future
Quality of Life, Economic Vitality, and other Factors

**Recommendations to the Commonwealth to channel Massachusetts' Future
to a New Innovative Future.**

Recognizing the Past, creating a tie to the future....
Selected Concepts that can create an economic future...
Proposed Legislation for viability and action....

12th generation, innovated by using a grain paddle wheel to aerate the water to increase production and growth. Today, paddle wheel aerators are still heavily used in the aquaculture industry.

Each and every subsequent move into an industry required innovation by Massachusetts' individuals. The whaling industry created a need for effective weaponry, and the whale oil led to better means to produce candles for lighting. Whale oil led to better lubricants, which resulted in more efficient machinery. Machinery allowed the move from an agrarian society to an industrial one. The industrial revolution led to more innovation and the move in the late 20th century to an informational technology sparked even more advances. Massachusetts has been at the lead in every transition.

Insert **The last American whale oil company** by PageWise, Inc.

Whale oil. The words conjure up romantic adventure on the high seas. Moby Dick, wooden sailing ships, living before the mast and bustling 19th century seaports like Nantucket and New Bedford.

But how many people realize whale oil was sold by a United States company as recently as 1978? And that that company, Nye Lubricants, is still selling the most highly refined synthetic oils in the world?

What exactly is whale oil and why was it so prized in times gone by? In the 1800s watches, clocks, and chronometers were the most precise instruments of the day. All needed lubrication to operate at peak efficiency. Watchmakers relied on concoctions of olive oils and nut oils. These potions were often found lacking in keeping these delicate instruments humming.

For centuries whalers were familiar with oil from the head and jaw of toothed whales, oil that never seemed to congeal, even in the sub-zero temperatures encountered in the Arctic. This unique oil was found in an organ called a "mellon," which is part of the sonar-like navigational system used by these gigantic mammals.

William F. Nye, a New Bedford, Massachusetts carpenter, first tried refining the "porpoise-jaw oil," as it was known, in 1844. By 1865, at the age of 41, he found enough takers for his wondrous oil to move into the whale oil business full-time. Nye was nothing if not a showman. In 1893 at the World's Columbian Exposition in Chicago, he introduced the "\$1000 Challenge." Nye offered to pay \$1000 to anyone "who could produce an oil equal to his oils, from animal, vegetable or mineral substance from land or sea." No one ever took the Challenge. Whale oil was indeed the finest lubricating oil in the world.

By 1900 nine out of ten barrels of dolphin-head oil sold were barrels of William Nye's oil. It was the most highly refined, most dependable lubricating oil available anywhere.

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But the supply of porpoises and whales was hardly inexhaustible and laws proscribing whale hunting were being passed in the United States. For decades Nye was able to obtain the precious "melons" from beached animals - whales, and porpoises naturally stranded by low tides. By the mid-20th century even this was impractical. With the passage of the Marine Mammal Protection Act in 1972 it became illegal for any American company to import raw material from marine mammals. Nye was permitted to deplete its current inventory of dolphin head oil until 1978, when it shipped the last bottle of whale oil ever sold in the United States.

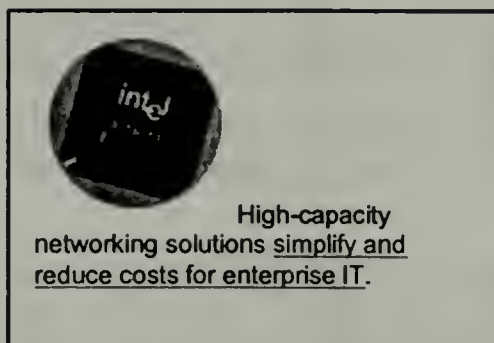
But this was by no means the end of William F. Nye, Inc. The founder had begun selling petroleum-based lubricants shortly after the Civil War and Nye had instilled a long tradition of innovation and expansion in his company. With whale oil no longer available the company was poised to become an important player in the expanding world of synthetic lubricants.

Today Nye Lubricants, the greatest purveyor of whale oil in the 19th century, stocks more than 400 custom formulations and a collection of specialty products.

Massachusetts has hundreds of similar stories of adaptation of science to formulate businesses, to expand businesses, and to retrofit businesses when conditions change. The Commonwealth has lead several overseas trade mission, three of which this author has traveled on. Firms like Avid Technology, Cerulean Technology, IBM Corporation, Intel Massachusetts, Raytheon, Environmental Research Corps, Sentinel Polyolefins, and others, some that still exist today, others in new names or consolidations traveled to Ireland in 1999 to look at the "Celtic Tiger" – Ireland's raging economy to look at export potentials. Likewise other missions to China, South America, Japan, Australia brought firms like Gillette, Ocean Spray, The Exeter Group, Pfizer, Sapiant, Viacell, and others to look at new regions and promote the uniqueness of Massachusetts science-based industries.



NyeCorr 125 (ISO Grade 220) and NyeCorr 140 (ISO Grade 460) are high-temperature, PTFE- fortified, perfluoropolyether(PFPE) greases formulated for heated roll bearings in single facers, the machines at the heart of the corrugating line.



The multi-media presentation will give you a look at some of the science based technologies in those countries visited on the Massachusetts trade missions. We have in this state the capability, the components, and the command of the science-based industries to compete. Let's use our science and technology to create a strong economic engine for Massachusetts.

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Advances in cell growth techniques allows for the rapid development of new medicines and treatments. Research in fungal growths, as shown here, lets companies such as Pfizer develop new drugs, and refines production in a timelier manner.

Massachusetts Assets – Leaders in Science and Technology Development

Sample Technologies

This is only a brief sampling of technologies found within Massachusetts. There is no intent to highlight or exclude any firm, nor does inclusion here serve as an endorsement.

BioTechnology & EcoTechnology

The biotechnology revolution is changing the world, as we know it. New techniques in laboratory science are enabling researchers to genetically transform plants and equip them with disease resistance, extract valuable pharmaceuticals, and develop commercial products for

a variety of uses. Likewise the eco-technology awareness makes environmental technology one of the fastest growing international industries. From providing cultural perspectives of protecting wetlands, woodlands, and wildlife; to reclaiming damaged industrial areas and controlling waste management, environmental technologies were responsible for four out of every ten jobs created in the 1990s.

Massachusetts is ideally suited for these industries. The state is home to hundreds if not thousands of trained researchers. Our resident population of scientists and researchers are readily capable of transforming the offshoots of research and development into commercial products. Our colleges and universities support these fields, with dedicated marine research centers, medical research labs, and environmental programs. We have industry support groups such as the Massachusetts Biotechnology Council, the Boston Consulting Group, the Massachusetts Technology Collaborative and others attempting to help Massachusetts achieve global leadership in the life science economy.

Our strengths in this industry are many. Many of the better health care solutions and environments are found in our state. Massachusetts is the leader in research and discovery. We are the headquarters for several of the world's fastest growing biotechnology companies. And we are home to one of the best places for students and professionals to study and innovate.

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A recent article in the Boston Globe spoke volumes about the industry and its direction:

WHERE THE BIOTECH JOBS ARE

Author(s): Davis Bushnell, Globe Correspondent Date: March 9, 2003 Page: G1
Section: Boston Works

Scientists and researchers are chasing fewer jobs this year in the biotechnology industry, which is plagued by a becalmed economy and a scarcity of venture capital with which to fund growth.

Specific job numbers are unavailable since there is no industry clearinghouse for employment data. But conversations with hiring managers and industry recruiters suggest new hires in 2003 will be fewer than in previous years. The companies that are doing considerable hiring in Massachusetts are those needing skilled specialists for furthering product development and bringing new medicines to market, industry executives say. Companies still feeding on large amounts of venture money and that have "multiple products" in the pipeline are the ones searching for many new people, said Neil DeAngelis, a partner and biotech specialist in the Boston office of Ernst & Young, the accounting firm.

The Abbott Bioresearch Center in Worcester and Biogen and Genzyme, both in Cambridge, are among area companies with major products seeking a large number of new hires in 2003. These companies expect to hire between them nearly 700 people worldwide, according to their human resources managers. Salaries typically are between \$50,000 and well over \$100,000 a year. Opportunities range from project management to the highest levels of research and product development.

Another bright spot is the arrival of Swiss pharmaceutical giant Novartis AG. It plans to hire as many as 400 workers this year and 900 over the next two years for its new global research headquarters in Cambridge.

It's still too early to tell what the hiring scene will be like in 2004, hiring managers say, stressing that everything will depend, again, on the state of the economy and product development stages at individual companies. Today, however, job seekers looking for work in the industry will have to work harder.

"Because fewer [biotech] companies are hiring, job seekers have to do more digging these days," said Pearl Freier, an executive search consultant in Cambridge who specializes in the biotechnology and pharmaceutical industries.

For example, BioSpace.com lists 1,200 biotech job openings nationally, about 60 of which are in Massachusetts, said Ian King, marketing director for the San Francisco-based website. King adds that a year ago, the total number of nationwide listings was approximately 1,500 and more than 100 in Massachusetts.

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"For one thing, biotech companies that have product are doing most of the hiring. For another, a vast amount of venture capital, which could be spurring [product] development, is now on the sidelines," King explained.

The Massachusetts Biotechnology Council does not track job openings but, instead, refers those who access its website (www.massbio.org) to companies that are hiring, said chief executive Janice Bourque. Companies posting positions on the site include SBH Sciences, Synta Pharmaceuticals, Linden Bioscience, Averion Inc., and Biopure Corp. Bourque agreed there's not an abundance of biotech jobs out there at the moment. The encouraging news, she noted, "is that for every job created, two more are created in support services, whether it's with a consulting firm or a supplier."

However, a report released last December by the Massachusetts Biotechnology Council and the Boston Consulting Group, said the state is losing ground in the race to be the nation's premier biotech center and suggested that if the trend is not reversed, it stands to miss out on nearly 100,000 new jobs and \$1 billion in tax revenue in the next eight years. Massachusetts' share of biotech jobs has declined in recent years, the report said. Venture investment has grown more slowly here than in rival hubs such as California and North Carolina. Major players have also located manufacturing operations outside Massachusetts, according to the report.

All Edwin Rich cared about was being able to land a job with Worcester's Abbott Bioresearch Center, a unit of the suburban Chicago-based pharmaceutical giant, Abbott Laboratories Inc. Last fall, the Westborough resident joined the center as a senior scientist, managing its DNA sequencing laboratory. He had worked for a small biotech company in Lexington, which failed last July.

"There's not much turnover of biotech managers anywhere, so I was fortunate to get this position when I did," Rich said.

Since 2001, Abbott has hired 200 people to work in its 380,000-square-foot Worcester facility. This year, it will add 100, said company president Alejandro Aruffo. Efforts are concentrated on developing biologic medicines for all Abbott Labs' specialty product areas, such as oncology, immunology, and cardiovascular. In early January, one of the center's most promising products, Humira, an antibody for treating rheumatoid arthritis, was cleared for use by the US Food and Drug Administration.

The center draws from "a good labor pool, and we're able to recruit people from wherever they are because they are excited about our products and our strategic location outside the Boston metropolitan area," Aruffo suggested.

In looking for a "few hundred" new hires worldwide this year, perhaps half from Massachusetts, Biogen is conducting searches among colleges and universities, research hospitals, other biotech companies, and large pharmaceutical firms, said Craig Schneier, executive vice president of human resources.

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"We've been adding significantly to staff the last three or four years - 900, for example, last year, with half of those being in Massachusetts - and with the recent FDA approval of our product for psoriasis, we think the employment outlook this year is bright," Schneier said. Biogen's psoriasis product is called Amevive. Another major product is Avonex, for treating some forms of multiple sclerosis.

Specialists being sought, he said, range from scientists with doctoral and medicine degrees, biostatisticians and drug safety managers, to sales, marketing, and customer service people. "The challenge, always, is to hire bright, flexible people before product-approval stages," he said, adding that the salary range of new employees this year will be between \$50,000 and more than \$200,000 a year.

Biogen's Cambridge neighbor, Genzyme, is looking to hire probably 100 specialists in Massachusetts this year, 80 elsewhere, said Jo Norton, director of work force development.

Positions include entry-level assistants to PhDs, medical doctors, and sales and marketing executives. They will be tied, in some way, to an enzyme-replacement therapy for a rare genetic disease called MPS1, Norton said. They will be paid from \$25,000 to more than \$100,000 a year, she said.

"We hope that this product, which is in the approval stage, will be marketed before too long," Norton added. The company expects FDA approval later this year.

Due to a small labor pool of highly skilled specialists and competitors' recruiting campaigns, it is never easy signing up scientists, she said. In contrast, unemployed information technology specialists have flooded Genzyme with resumes, said Norton.

"We now have hundreds of resumes from those people and don't need anymore."

Looking ahead, it's difficult to predict employment prospects in biotechnology because of a possible war with Iraq and the economy, said Freier, the executive search consultant.

"But as companies come out with new products, as they will, different skills will be needed at different times," she said.

Davis Bushnell is a freelance writer and can be reached at davisbushnell@compuserve.com.

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By any measure, Massachusetts is at the heart of the biotechnology and eco-technology industries. This is a remarkable engine of innovation that fuels new jobs, and changes the quality of people's lives for the better. Massachusetts needs to capture the full benefit of these industries.

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Science and Technology as an Economic Engine for Massachusetts' Future

Our Heritage as Innovators

A quick sampling looking at historical notes about Massachusetts proves that innovation and ingenuity are part of our heritage.

From the Pilgrim and Puritan days of old when "masters and maidens" were the language of the day; "masters of science" – modern technology in all its aspects, is a more apt description for Massachusetts today.

Innovation in Massachusetts History

- 1602. Bartholomew Gosnold explores coast.
- 1620. Plymouth Company reorganized as Council for New England. Pilgrims land; found Plymouth; elect John Carver governor.
- 1621. Pilgrims celebrate the first Thanksgiving in Plymouth.
- 1628. John Endecott founds Puritan settlement in what is now Salem.
- 1629. Massachusetts Bay Company chartered.
- 1630. Dorchester founded. John Winthrop and group of settlers establish Boston.
- 1632. Boston made capital of Massachusetts Bay Colony.
- 1634. Boston Common became the first public park in America.
- 1635. The first American public secondary school, Boston Latin Grammar School, founded in Boston.
- 1636. Harvard, the first American College, founded in Newtowne (now Cambridge).
- 1639. First commercial printing press in English-speaking North America set up in Cambridge by Stephen Daye.
- 1639. The first free American public school, the Mather school, founded in Dorchester, a neighborhood of Boston.
- 1643. The first American ironworks established in Saugus.
- 1653. The first American public library founded in Boston.
- 1675-76. King Philip's War brings Indian attacks on settlers.
- 1684. Massachusetts charter annulled.
- 1686. Dominion of New England established.

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- 1691. Massachusetts granted new charter; becomes royal colony including Maine and Plymouth.
- 1704. The first regularly issued American newspaper, The Boston News-Letter, published in Boston.
- 1716. The first American lighthouse built in Boston Harbor.
- 1770. British troops shoot colonists in Boston Massacre.
- 1773. Boston Tea Party dumps tea into bay. Colonists at Faneuil Hall, in Boston, oppose taxes.
- 1775. The first ship of the U.S. Navy, the schooner "Hannah", commissioned in Beverly.
- 1776. Colonial troops force British to evacuate Boston.
- 1780. State constitution adopted; John Hancock becomes first elected governor. Oldest constitution in existence, a model of government
- 1788. Massachusetts is sixth state to ratify the United States Constitution on Feb. 6, 1788.
- 1789. The first American novel, William Hill Brown's The Power of Sympathy, published in Worcester.
- 1806. The first church built by free blacks in America, the African Meeting House, opened on Joy Street in Boston.
- 1820. Maine separated from Massachusetts.
- 1822. Lowell set up as factory town. Boston chartered.
- 1826. The first American railroad built in Quincy.
- 1831. The first abolitionist newspaper, The Liberator, published in Boston by William Lloyd Garrison.
- 1833. Constitutional amendment separates church and state; ends Puritanism in government.
- 1837. State Board of Education established under leadership of Horace Mann.
- 1839. The first vulcanized rubber produced by Charles Goodyear in Woburn.
- 1845. The first sewing machine made by Elias Howe in Boston.
- 1846. The first public use of ether anesthetic demonstrated in Boston.
- 1863. University of Massachusetts chartered at Amherst.
- 1875. The first American Christmas card printed by Louis Prang in Boston.
- 1876. The first telephone demonstrated by Alexander Graham Bell in Boston.
- 1886. The first transformer demonstrated by William Stanley in Great Barrington.
- 1891. The first basketball game played in Springfield.
- 1892. The first successful gasoline-powered automobile perfected by Charles and Frank Duryea in Springfield.
- 1895. The first volleyball game played in Holyoke.
- 1896. The first American public beach established in Revere.
- 1897. The first successful American subway system opened in Boston.
- 1914. Canal links Cape Cod Bay with Buzzards Bay.

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- **1926. The first successful liquid fuel rocket launched by Dr. Robert Goddard in Auburn.**
- **1928. The first computer, a non-electronic "differential analyzer," developed by Dr. Vannevar Bush of M.I.T. in Cambridge.**
- **1944. And, not to be outdone by M.I.T., Howard Aiken of Harvard developed the first automatic digital computer.**
- **1957. Massachusetts Turnpike opened.**
- **1960. John F. Kennedy, born 1917 in Brookline, elected 35th president of United States; assassinated 1963.**
- **1961. The first nuclear-powered surface vessel, USS Long Beach CG(N) 9, launched at Quincy.**

This heritage brings us to the 1960s, the era now known as the dawn of a new age. From this point on, innovation, break-through, discovery happen so quickly that listings become impossible. Though the last four decades, Massachusetts has built on its heritage, continue to be on the cutting edge of ground-breaking technology.

Massachusetts is home to more than 405,000 manufacturing jobs across 435 cities and towns. We have over 9000 manufacturing companies. Boston has the second highest concentration of high-tech jobs in the country, and there are hundreds of companies that make everything from semiconductors to computer peripherals to pharmaceuticals, to communications equipment in the science and technology industry.

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**Science and Technology as an
Economic Engine for
Massachusetts' Future**

**The Key to Massachusetts'
Economic Future**

It is significant to note our economic progress over the last decade, and the state must have a shared vision for economic development as it goes forward.

There are key factors for our economic future. Vital not only to the science and technology industries, these factors are common to all our Massachusetts industries.

Factors such as:

- Improve the business climate in all regions of the Commonwealth
- Support entrepreneurship and innovation with investment and policy
- Prepare the workforce for the future with training and education
- Ensure that economic growth is blended with community and environment
- Improve the role of government action and interaction with business.

Our past economic pillars, industries like banking, tourism, insurance, and others still maintain a vital economic role in Massachusetts. But as these industries reach growth maturity, viable replacement is seen in the science and technology industries. We need to search out these markets, both current and new, find out why they appear to be stalling or slumping, find out what it takes to get them moving again, assess our competition, and adjust our promotion schemes and governmental policy accordingly. New enterprises can pick up the slack and employ a growing young population insuring that they contribute to Massachusetts' future.

Looking ahead, we need to reach out to scientific advances and technological innovations for new methods and new techniques that will keep us at the global cutting edge. As things stand now, Massachusetts' economic future lies with knowledge-intensive industries. Knowledge, and the skills to produce and utilize knowledge are our real wealth and tools for the future.

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Our keys to an economic future might be summarized as follows:

- provide leadership and focus in promoting the state's science and technology capabilities and resources
- increase by policy changes, the state's organizational approach to science and technology activities, prioritize changing procedural methods of working with S&T firms, make a commitment to financial efficiencies and assistance to promote the industries.
- link our science and technology capabilities and resources to overseas markets by increasing exporting assistance, information transferal, and incentives.
- expand the partnership between government, academia, and industry to maximize our competitiveness in national and international markets.

We might be guided in understanding concepts that will allow a shift toward technology-based economic development:

- capitalizing on our strengths – location, resources, resident workforce, on-going research, academic support for technologically related areas.
- recognizing that the value of a science and technology based industry relies not only on establishing industries that develop new, innovative, or high-tech products and services; but also promote and assist the firms that can apply them, using the spin-offs from research and development to move forward in a broad range of industries.
- gaining accountability by requiring measurable outcomes from program implementation and policy changes.



Titleist Golf Balls, imprinted with various company logos provide an example of how a firm located in one corner of Massachusetts can gain worldwide recognition for its technologies, scientific innovation, and production techniques

It should be the role of state government to support a strategic planning process whether it comes from in-house from governmental policy leaders, or from industry and trade support groups, or from academia.

It is felt that a primary key for the Commonwealth to consider is to retreat from being a manager and regulator of industries, and migrate to being a facilitator – working with markets, rather than just regulating them. The government should

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work with local market factors that will support the growth of local science and technology industries.

There needs to be an emphasis on:

- obtaining support from all science and technology business, from organized labor, and from all university and college policy efforts.
- involving these interests as partners in the policy changes and ultimate implementation of policy.
- promoting a political climate conducive to cooperation and partnerships between government and the private sector.
- requesting that a core of the active, creative, and involved private entrepreneurs serve as liaisons and sounding-boards for the Commonwealth's proposed governmental policy changes, regulation development, and investment strategies.
- remain sensitive to local changes, remain aware of evolving technologies, and use a foundation to policy change which includes both long term and short term goals.

So it can be summarized that not only is science and technology a key to Massachusetts' economic future, but that our future must hold the keys to change and support to realize that prosperity. Change does not come from innovation alone, the Commonwealth needs to implement key changes to policy, regulation, and incentives to channel our future into a new direction.



Science and Technology as an Economic Engine for Massachusetts' Future

Roadblocks and Stumbling Blocks

It is impossible for any one individual to highlight all the stumbling blocks and detrimental roadblocks confronting science and technology industries. Details of many of the impediments to the advancement of the industry can be found elsewhere; documented in the state agencies, in the private trade groups, in our colleges and universities, and elsewhere.

Yet, some barriers to our promising future can be exemplified. As the author of this report, I step back from my role as a State Representative and instead speak as a private

business owner. I am the CEO and Chief Biologist of two firms – Environmental Research Corps in East Freetown, Massachusetts, and BioMass Farms in Lakeville, Massachusetts. ERC is the only firm in the United States to win back-to-back EPA award for environmental technology – one for stormwater mitigation, the other for erosion control. BioMass Farms manufactures those award-winning technologies.

I believe a component of being a State Representative includes using one's experiences and talents to assist the Commonwealth. As such, I speak of the products and services produced by my firms, not in an effort to enhance their viability, but to demonstrate the roadblocks and stumbling blocks of various scientific discoveries made by firms I control as they moved from research and development to production. I specifically declare that I ask for no relief from regulatory, constitutional, or financial relief to the conditions I will describe using examples from my firm's work to highlight the impediments on science and technology. I have spoken with the State Ethics Committee and received clearance to discuss my private role as long as it does not realize myself any immediate financial gain. As the impediments to these products' development occurred long ago; I stand to gain no financial improvement today from discussing those past impediments at this point in time, and request no action from legislators to correct past actions or inactions.

There are many other impediments to the advance of science and technology as an economic engine. Only a few are highlighted here. The Science and Technology

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House Committee has been charged by the Speaker of the House to explore all the barriers for this industry. It is trusted that as a member of that committee, that the contribution made here will lend to that effort.

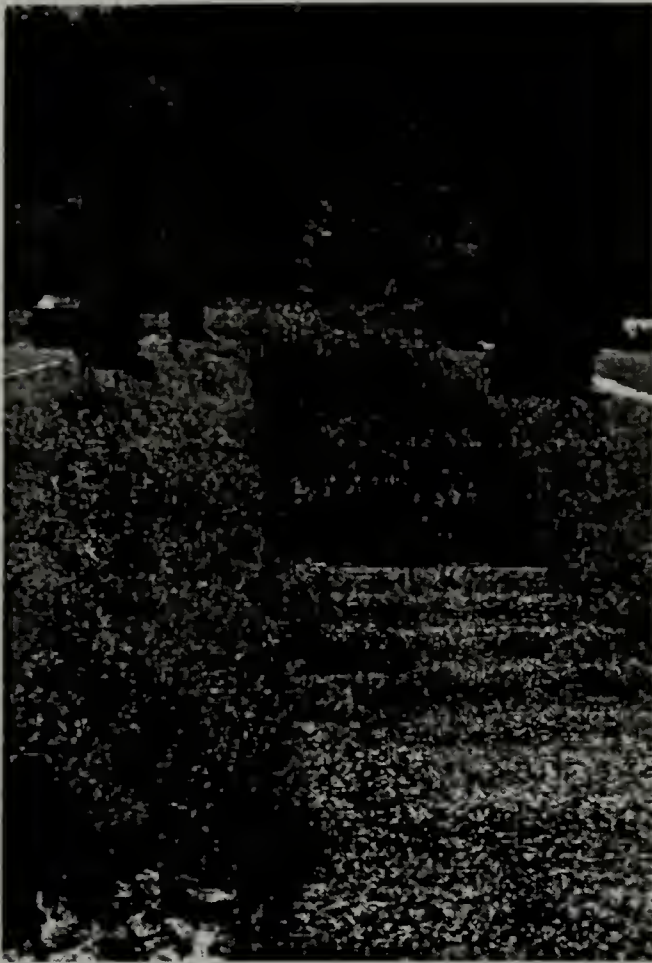
As examples of some impediments, the following cases will be presented:

1. the intellectual theft of property
development of technology, protected by patents and copyrights – subsequent use of information by state entities and others
2. the recognition of new technologies
bureaucratic roadblocks to new innovation. The glacial pace of allowing new product introduction to the marketplace, and the slow acceptance by regulatory agencies in some cases, and the inconsistency allowance of non-Massachusetts cases in others
3. the stumbling blocks presented by government
an example of the non-awareness of new technology, a refusal to allow test trails and/or implementation after successful demonstration elsewhere
4. the roadblocks of regulatory action
the confusing and contradictory path of regulatory permitting, the cost of delays, the loss of advancement of an industry

Again, the following cases are exemplary in nature only, and are not intended to request particular governmental interaction. It is hoped that the overlying message of roadblocks and stumbling blocks can be seen in each of the examples presented.

Each of the four listed impediments will have a case study presentation format on separate pages to follow. At this time, it is requested that other roadblocks and stumbling blocks be considered briefly as well, and expanded upon by others to insure a complete appraisal of our needs for the future... Suggested subjects might be, but not limited to....

- workforce needs
- financial support
- tax incentives
- training components
- database and indexing of technologies
- market promotion and export assistance
- change investment laws and legal definitions
- merge academia and private sector interests
- appraise housing needs and travel components for workers
- environmental injustice



The 1998 EPA Award Winner for Environmental technology – the Howland Swale™ – is a constructed wetland system designed to use natural wetland plants and construction techniques to remove pollutant from runoff. Here, at GTE Laboratories in Waltham, this stormwater swale treats the runoff from two employee parking lots and prevents the pollution of the nearby Cambridge Reservoir – part of the City of Boston water supply.

Science and Technology as an Economic Engine for Massachusetts' Future

Roadblocks and Stumbling Blocks

Sample Case – Intellectual Theft of Property

Before a case study is presented on a roadblock to economic development, let's talk about the topic in general.

Intellectual theft of property. In actuality, this scenario often begins like this....

"A young scientist in a lab. She was given a grant by her university, and a stipend from her government. She works on the research they direct, yet her creativity entices her to look at a different way to create a solution. One day, after tweaking a few things, after tinkering with alternatives, after abandoning the directives she has been issued; EUREKA !

A new way to produce a vaccine quickly and with fiscal efficiency based on a quick blood sample rather than a detailed disease analyses.

WHO OWNS THE RIGHT TO HER DISCOVERY?

Many inventions and discoveries start out with a scientist being given the freedom to experiment as one wishes. Some discoveries may bear little fruit, others change our lives profoundly. For many, the argument of university support of technology transfers is clear, spin-offs from technological innovation benefit our economy. We have a choice with intellectual property – we can try to lay claim to it, prevent it's life-altering abilities from reaching the market; we can say we don't care about it as long as it is not developed here, and allow it to be licensed out of the state or country and used as the basis of economic development elsewhere; or we can encourage that this type of intellectual property be developed within the state, and by doing so have lots of strong companies that pay taxes and also employ lots of people who in turn pay taxes.

It is needed to develop a policy on the right to intellectual property.

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Let's take a brief look at a type of intellectual property compromise....

CASE STUDY #1 – by Mark A. Howland

Technology Type: Stormwater Treatment

Technology Description: THE HOWLAND SWALE is a copyrighted and patented constructed wetlands stormwater management system that won the 1998 EPA Environmental Technology Innovator Award. Our award reads in part - *"in recognition for the Howland Swale, an innovative approach to storm water mitigation and water treatment that utilizes both engineering and biological control processes. Your ingenuity and vision will help protect our Nation's water resources and the environment for future generations"*.

Mitigation of Storm generated runoff waters is a relatively new concept as more people realize the damages created by uncontrolled runoff. For many years, the damages were thought to be limited to siltation and erosion, and controls were designed around those impacts. The volumes of water generated however, and the pollutants they carry have not been addressed until this decade in detail.

Calculations are generated in terms of cfs - cubic feet per second of runoff. This usually refers to the increased amount of water that the proposed building project that man creates on undisturbed land will create after construction. As raw land of trees, shrubs, and uncovered soils is changed to houses, streets and pavement, or business, factories, and plazas; the land can absorb less water due to the new impervious surfaces. This water now flows across the surface of the land rather than percolating to the groundwater until it reaches a point where there is a pervious surface it can percolate into. In many cases, this new percolation entry point is wetlands. The change creates two disadvantages. First, there is a loss of filtering of the runoff immediately, as the initial percolation upon point of contact is lost, as rainwater now longer is soaked directly into the ground being filtered by layers of soils. Secondly, the new surface flow of runoff generated by the rainfall, now picks up silt, pollutants, and joins with more runoff to create a larger, more polluted flow for the new percolation entry point to handle.

Traditional designs worry only about the increase speed at which this new flow moves. Engineered designs such as the commonly-used detention basin are created to slow the flow down until it matches the speed the natural pre-developed flow would have been. However, though the flow has been decreased and the volume metered into the wetlands, little is done to treat the pollutants that have been picked up by the surface flow.

The concept to mitigate these volumes combine the traditional detention basin designs of the engineers with biologically engineered mitigation structures in a specialized design unit. E.R.C. has dubbed these award winning structures the "Howland Swale™" Duplicating the pollutant removal capability of nature as much as possible, the concept relies on the pollutant-stripping ability of plants and soils to remove pollutants from the runoff waters. To mitigate from the dangers outlined earlier, vegetative controls are designed here to be placed into operation in lieu of an engineered detention basin. In other words, we use the biological best of nature to compete with the concrete structures of man to remove pollutants from runoff water.

There are four major components of the Howland Swale.

From the source of runoff waters collecting in the drainage system from various catch basins, the flow first enters the siltation trap portion of a Howland Swale. This silt trap is lined with large, then small riprap stone to break up the velocity of the flow and trap larger particles of sediments. It also functions as a small detention section as often, it is designed to retain the 1 or 2 year storm events for slow treatment by the next stage. This allows a more complete washing of pollutants in the initial flush of waters where 90% of the common pollutants found in runoff waters are held..

The second stage is a pre-treatment marsh that removes a majority of the pollutants. Specifically designed to function as a natural wetlands, this collection of design selected plants, hydric soils, and flow paths specifically trap and absorb pollutants before passing flows on to the next stage. Measurement of uptake levels of pollutants in past applications have been astounding - in the 93 - 98% TSS removal range as well as high heavy metal collection, and bacterial breakdown of nutrients. ERC custom designs each swale for each type of runoff scenario, and constructs this area by choosing special plants to treat the appropriate situation.

The third stage is the traditional detention basin with one twist. We call it a vegetated detention volume adjustment chamber. Volume-wise, the elongated swale will hold the same amount as designed previously for a basin in an 100 year storm event, but E.R.C. advocates vegetating the swale with extraordinary wetland plants. Vegetation allow for greater water storage (in the plants themselves), increases filtering capacity, and allows for less maintenance of the structure as there will be no exposed sides of the basin to erode and fill in the storage volume. We have found that the design of a Howland Swale involves a much smaller area for town DPW crews to clean and maintain.

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State Representative Mark A. Howland
12th Bristol District – Freetown, New Bedford, Lakeville, Middleboro, & East Taunton

The fourth stage is a vegetated takeoff channel. This channel allows a final washing, velocity reduction, and filtering of waters before discharge toward wetland systems. They are designed to replace the common riprap outflow structure, where the riprap stone adds nothing to treatment of pollutants. In smaller subdivisions, we have found these channels work so well in controlling flow that they can be used in lieu of riprap swales in that they have the ability to mitigate velocity and volume as well as filtering pollutants. For flows under 5 cfs, they can alone reduce velocity to no net change.

Application and Environmental Benefits

The Howland Swale accomplishes its pollutant and TSS removals by several interlocking factors. The swale moves from accomplishing its greater than 80% TSS removal even in early constructed stages, and moves to 100% complete pollutant removal in mature stages.

Application: The Howland Swale™ is appropriate for all types of commercial and residential development or runoff situations. ERC custom designs each swale for each type of runoff scenario, and constructs the detention basin by choosing special plants to treat the appropriate situation.

Environmental Benefits: The company reports that the swale significantly reduces TSS and particles suspended in runoff. It also performs high heavy metal collection, and bacterial breakdown of nutrients.

Performance

The Howland Swale is a process that addresses the 80% or higher TSS removal rate mandated under Massachusetts' DEP Performance Standards and Guidelines for Stormwater Management, and the EPA's Clean Water Act Stormwater management standards. This document is designed as a guidance document to address these issues and remains a copyrighted material of Environmental Research Corps. Use of this document to design swales not authorized by ERC involves patent violation issues, and may lead to infringement actions. The swale moves from accomplishing its greater than 80% TSS removal even in early constructed stages, to 100% complete pollutant removal in mature stages. Approximately 90% of the particles found suspended in runoff have been observed to settle in the siltation trap. The pre-treatment marsh section of the Howland Swales™ is sized to address a pollutant uptake of over 80% of the expected volume of volume to pass through the swale in storm events. With most pollutants found in the initial one year storm events, 100% uptake ratios are achieved in the smaller storm events carrying the bulk of the pollutants.

Stormwater Management Rating level average for Howland Swales upon Construction
88% average rating (minimum standard is 80%)



Stormwater Management Rating level average for Howland Swales upon Maturity
97.85% average rating (minimum standard is 80%)

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ERC 15 Mohawk Ave., E. Freetown, MA 02717

Limitations

**Using Science and Technology to create
An Economic Engine for the Commonwealth**

State Representative Mark A. Howland
12th Bristol District – Freetown, New Bedford, Lakeville, Middleboro, & East Taunton

The Howland Swale is a copyrighted design of Environmental Research Corps. E.R.C. has also a patent for this design and unit. As such, the design - and its use and implementation - are the property of E.R.C. Unauthorized use will result in legal actions.

We have done this basically to insure two things. Traditional detention basins were rubber-stamped designed in subdivision planning with little regard to actual site conditions. Many basins are ill-suited for their locations and fail to function efficiently. Thus, the detention basin has gotten a bad name. We hope to avoid this problem with the Howland Swale by insuring each and every Howland Swale has been custom designed by E.R.C. to its location to insure proper functioning. We hope our engineers and surveyors will honor our request to have E.R.C. involved in every design. To use the design without E.R.C.'s involvement may mean a violation of our patent laws as well as a degrading of the Howland Swale's reputation. Secondly, the patent insures E.R.C. of income to continue to develop innovative technologies for environmentally aware planning.

In order to design a Howland Swale, E.R.C. will need to obtain the following information:

1. Pre/Post drainage calculations preferably in TR55 format. A summary sheet is sufficient as long as it shows pre-development C.F.S. discharge figures as well as post-development. Also, a calculation of the storage volume needed for use of a traditional basin would be helpful. For those who have not conducted drainage calculations, E.R.C. is available for these services.
2. Wetland boundaries and soil types. E.R.C. prefers to gather this information themselves, and envisions that E.R.C. will be contracted to provide these services in the course of the subdivision planning.
3. Site plan, lot locations, roadways, discharge points planned. We envision that the preliminary subdivision plan is completed and that this information is available to E.R.C. for use.

Arranging to use a Howland Swale in your next subdivision plan is a simple matter of contacting Environmental Research Corps.

Our phone number is 508-763-5253, which has a 24-hour answering machine to leave a message. Someone will get back to you as soon as possible. Our fax number is 508-763-8781. Correspondence, plans, locus, and other information can be sent to this full-time fax number at any time.

The Howland Swale was originally named the Yankee 3-stage Detention Structure after ancestors of Mark A. Howland - the swale's designer. However, it's rapid popularity has caused it to be linked more closely to the Howland name, and the Howland Swale terminology has stuck.

Mail may be directed to:
Environmental Research Corps, 15 Mohawk Ave., E. Freetown, MA 02717

Cost

Howland Swale estimates are as follows:

1. All units are custom designed, thus pricing is custom-quoted. Pricing quoted here is provided as rough guidelines only.
2. The design cost for a swale is between \$400 and \$600. The lower figure reflects a site in which E.R.C. has had prior involvement such as wetlands flagging. The design fee includes a meeting attendance presentation, design component sketches, and a 25-40 page narrative describing particular design components peculiar to the locus studied.
3. Construction of a Howland Swale is available only through BioMass Farms (sole authorized construct firm), who may be contacted through E.R.C.'s offices at the numbers above. At this time, construction costs are running about \$10.00 per linear foot (i.e. - a 140 foot swale recently cost \$1425.00 to construct for a six lot subdivision). These costs are less than or comparable with basin construction costs, and includes materials and plantings.
4. Extraneous hearing attendance is billed separately.

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This is the introduction page to the stormwater technology developed by ERC in 1993. From 1993 to 2000, ERC sold 1143 units of Howland Swales™ to developers, commercial properties, and others. From 1993 to 1997, over 800 of the units were sold, and average of 200 per year. In 1997, DEP released Stormwater Performance Standards and included non-standard treatment standards in those regulations. ERC had been contacted by Christy Foote-Smith, regional director for DEP and author of the Stormwater Performance Standards regulations, and she inquire about the parameters of the ERC technology. In late 1997, just before ERC won the 1998 EPA Environmental Technology Award based on EPA testing results from 500 Howland Swales tested between 1995-97, DEP issued stormwater guidelines including accepted alternative technologies. The included described technologies for constructed wetlands and stormwater swales included word-by-word descriptions of ERC's copyrighted technology – 8' wide bases, 4:1 side slope, three components of pre-treatment, vegetative treatment, and storage components – and there was no credit for ERC innovation or work or development of the technology.

Since the DEP performance standards were released, sales of our stormwater technology have dropped from 200 units per year in Massachusetts to less than 50 in 2000, to now less than 15 in 2002. Conversely, sales of the Howland Swale™ stormwater treatment units in Connecticut rose to over 100 in 2002, and sales in Florida, California, Michigan, Oregon, and other states with stormwater performance regulations rise rapidly as well, while sales in Massachusetts plummeted. Additionally, the number of units in Massachusetts in 2002 designed by Civil Engineers with an apparent similarity to the trademarked swales based on the published DEP guidelines, now number over 300 units per year. Obviously, the technology is valued, the intellectual property rights are not.

It is not difficult to see how the state agency seized upon a technology recognized by the federal government, yet privately developed. Or to see that once incorporated into performance guidelines by DEP, the intellectual theft of property had a direct and detrimental impact to sales of a private, and innovatively-recognized company, purely through the disrespect to the rights of intellectual property.

Science and Technology as
an Economic Engine for
Massachusetts' Future

**Roadblocks and Stumbling
Blocks**

Sample Case – Recognition of New
Technologies

Let's take a look at another
type of stumbling block –
product recognition.



CASE STUDY #2 – by Mark A. Howland

Technology Type: Erosion Control

Technology Description: BIOFENCE was developed to 1/provide greater silt removal than the hay bale/silt fence combo, 2/use materials that are totally biodegradable and non toxic to prevent placing lubricant laden plastics and weed and invasive seed entry in wetlands during erosion control, and 3/ provide a product made in the United States to reduce foreign imports and offer better price advantages.

BioFence was developed in 1994. A niche product that grew into competition for silt controls, it has several advantages. Most black plastic silt fence comes from the Far East and shipped to Georgia where oil lubricated rollers trim it to size. Most hay bales are Canadian, contrary to misconceptions that they come from small local US farmers, and are straw or hay meaning a seed content in the bale. When we first designed BioFence, about 34 versions were initially designed, and tested for biodegradability. The final product version selected was about 10-20% better than hay bale/silt fence combinations in silt catching/blockage. Our reasoning is: One - a blade of straw in a hay bale has a hard, shiny, and smooth coat which catches no silt as the individual blade of the hay bale. The silt trapping in a hay bale comes from the intersecting pieces of straw in the bale, but not from the pieces themselves. BioFence also has the intersecting action but adds interlocking ability of the excelsior fiber providing additional silt trapping in the aspen wood fiber section of the fence. Rough edges in the individual pieces of aspen catch silt as well, so the result is blockage by the intersecting and interlocking action, and trapping by the individual wood fibers themselves. BioFence's backing material varies from the hydrocarbon sourced plastic fibers in a black plastic silt fence, that does not shrink nor swell in rainfall events. BioFence uses a treated, dense 8-10 ounce weave burlap composite. Swelling in storm events for a smaller hole opening (which means greater silt trapping), and drying out when the storm recedes, the opening re-establishes itself to allow water passage.

Most traditional black plastic fences are attached to the stakes by stapling. Staples are thin flimsy attachments for the weight fill can place against a silt fence. BioFence is made by sewing looped seams to insert wooden stakes. BioFence's 4' or 42" stakes places the stake 12-18" into the ground rather than the usual 8". In soft soils the fence cannot bend over and with the stakes imbedded into the fence, the fence cannot rip away from the stakes. With the stakes installed as part of the assembly, the client is really getting a complete ready-to-install unit for erosion control and does not need to go out and buy stakes.

All these methods really make us feel that BioFence is superior to any other means of silt and erosion control.

Application and Environmental Benefits

BioFence vs Other Siltation Controls

(materials cost comparisons only - no labor estimates)

BioFence regular grade \$1.50/ linear foot retail cost
AS MANUFACTURED BY ERC/BIOMASS FARMS, LAKEVILLE, MA
one man install time per 50' roll: 6 - 7 minutes

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advantages: quick install, aesthetic, biodegradable, no removal afterwards
comes with stakes inside fence, no stapling, sealant flap on
bottom can be trenched or erosion stapled, less maintenance
longevity: 1.5 years on average..... effectiveness: 1 year on average

Variations: BioFence Plus! - wildflowers embedded in fence for aesthetics
BioFence w/ EcoGuard - a natural oil absorption boom in fence for pollution control
BioFence w/ Skeeter Guard - fence impregnated with Bti mosquito larvacide to kill larvae
BioFence w/ Skeeter Repel - fence coated with pyrethrum to repel adult mosquitoes
BioFence Superior - heavyweight/high velocity grade for steep runoff situations

HayBales alone with double stakes \$1.80/linear foot average
one man install time per 50' roll: 40 minutes
longevity: 0.5 years on average..... effectiveness: 6 months on average
Variations: straw based, hay based, salt marsh hay based

Plastic Silt Fence with staking \$0.53/linear foot average
one man install time per 50' roll: 10 minutes
longevity: 20 years on average..... effectiveness: 3 - 6 months on average
note - requires additional labor for fence removal after use, more maintenance
Variations: some have stake attached, all involve stapling method

Hay Bales with Plastic Silt Fence \$2.20/linear foot average
one man install time per 50' roll: 60 minutes
longevity: 20 years on average..... effectiveness: 6 months on average
Variations: see above, effectiveness depends on which side the plastic is placed
note - requires additional labor for fence removal after use, maintenance

EcoFence \$0.60/linear foot retail
AS MANUFACTURED BY ERC/BIOMASS FARMS, LAKEVILLE, MA
one man install time per 50' roll: 7 minutes
longevity: 1.5 years on average..... effectiveness: 1 year on average
notes - biodegradable, replaces traditional plastic silt fence

Performance

Materials: BioFence uses 8 to 10 oz, 20 mesh seine weave burlap composite. Burlap is corn starched stiffened with natural additives for longevity to replace the black plastic silt fence. Fiber matting is aspen wood based excelsior fiber to replace the hay bale. The BioFence comes as a complete unit replacing both black plastic silt fences and hay bales. Seam threads are 100% cotton strengthened by twisting action. Matting attached to backing by 100% cotton cord. Reinforcement netting is biodegradable and photosensitive organic with corn starch additives. Paint lettering is soybean based and nontoxic. Stakes are 100% wood (hardwood) with 1 1/8" thickness sewed into fence upon manufacturing. 6" flap on bottom to seal bottom edge to ground via trenching or stapling. USA made and assembled ! Distribution across the USA with exports to Canada and the European Union, (Europe through N. Ireland and France), and the Far East through Honolulu, Hawaii. BioFence is also licensed for manufacturing in Australia and New Zealand.

BioFence is a haybale / plastic silt fence replacement. Its ease of installation and complete biodegradability make it the choice for developers and regulators alike to use in lieu of hay bales or bale/plastic fence combos. BioFence can be installed in a matter of minutes, and offers superior erosion control, water absorption, sediment reduction, and overall performance over straw hay bales and synthetic silt fences. Installation of a 50' length is much more cost-efficient for labor than hay bale installation while maintaining material costs in the same range, or often below the cost of doing it the old way !.

Attributes: - A roll of BioFence approximately weighs 42 lbs. and covers approximately 50 linear feet. It compares in cost to other erosion products with BioFence at \$1.50/lf having a much lower cost than the \$1.80/ft. average for haybales and stakes. BioFence is designed to replace the hay bale/silt fence combination (\$2.20/lf average) at the lower cost of \$1.50/lf, and offers superior performance to the haybale and silt fence combination at a minimum of 17% greater efficiency.. Labor costs for BioFence involves 6-7 minutes installation per 50' roll (estimated cost - \$1.50) versus over 1 hour average for the hay bale/ silt fence combo of similar length (estimated cost - \$40). As well, one roll of BioFence weighs approximately 42 lbs - much lighter than lugging 17 hay bales at 50lb each, and backing it with black plastic (estimated over 1000 lbs !) BioFence biodegrades in about 1.5- 2 years, and is available year round. It's design also makes it 17-30% more efficient in trapping silt than the other alternatives ! It means there is no residue plastic left in wetlands to remove after the project, nor weed invasion from straw or hay bales to worry about. Both hay bales (a mess to remove after the project) and black plastic (often buried in silt, and expensive to dispose of in dumpsters) mean labor consuming activity for the contractor long after the project is complete. BioFence means no return to the project after completion and no labor costs for removal!

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A close up look at the fibers that provide superior silt removal? Composed of aspen wood fibers, the irregular edges of the wood fibers catch small silt particles better than the round edges of a piece of straw or the smooth plastic fibers of silt fence. Coupled with the swelling ability of the natural burlap backing; BioFence routinely performs 17-30% better than hay bale or plastic silt fence alternatives in trapping silt and erosion.



WHY BIOFENCE PERFORMS BETTER..... *"Think of the hard shiny coat on a piece of hay. The individual strand of hay has no ability to attract silt on its own; it is merely the fact that there are thousands of interlocking pieces of hay in a bale that slows and stops silt. Combine this interlocking action of thousand of strands of aspen wood fibers with the fact that the individual strand of aspen has rough edges and traps silt particles on its own - you now have increased silt trapping ability. Along with the aspen wood fibers used in BioFence, the backing material of corn starch stiffened burlap also catches small particles on its own. Unlike plastic silt fences, the burlap will swell during a storm event tightening the 20 mesh weave that BioFence employs, trapping silt on its own."* With its embedded stakes, the fence also requires no staples, so the fence can not rip away from the staking.

Limitations

BioFence is a copyrighted, trademarked, registered, and patented product of Environmental Research Corps. As such the product, along with its design and usage, are strictly the property of Environmental Research Corps and its affiliates. Unauthorized use, design copy, or name use of either BioFence or EcoFence will result in legal infringements and legal action.

A New Way to Provide Erosion and Silt Control

- No heavy hay bales to lug
- No plastic left in wetlands
- No time consuming installation
- No removal needed afterwards
- Cost effective at ½ the price
- Takes the place of both hay bales and black plastic silt fences

Cost (all prices are MSRP - manufacturers suggested retail price)

The BioFence line all rolls are 50' in length

BioFence regular: designed to replace hay bale and plastic silt fence combinations - \$75/roll

BioFence superior: uses a double application of excelsior and heavy duty backing for longer life expectancy - \$85/roll

BioFence Plus !!!: choice of wildflowers with nutrient gel embedded in fence upon assembly for later growth - \$85/roll

BioFence with Skeeter Guard & with Skeeter Repel: we impregnate BioFence with pyrethrum to repel mosquitoes or with Bti larvicide....\$85/roll

BioFence with EcoGuard: a natural corncob/cellulose oil absorption boom is embedded into BioFence upon assembly - \$125/roll -

The EcoFence line

EcoFence regular - 50'

10 oz. stiffened burlap includes embedded stakes, and drawstring. Intended to replace traditional

black plastic silt fence only with the same biodegradability as BioFence and more effective strength - \$30/roll

PRE-PAID, S&H NOT INCLUDED- *contact us about other arrangements*

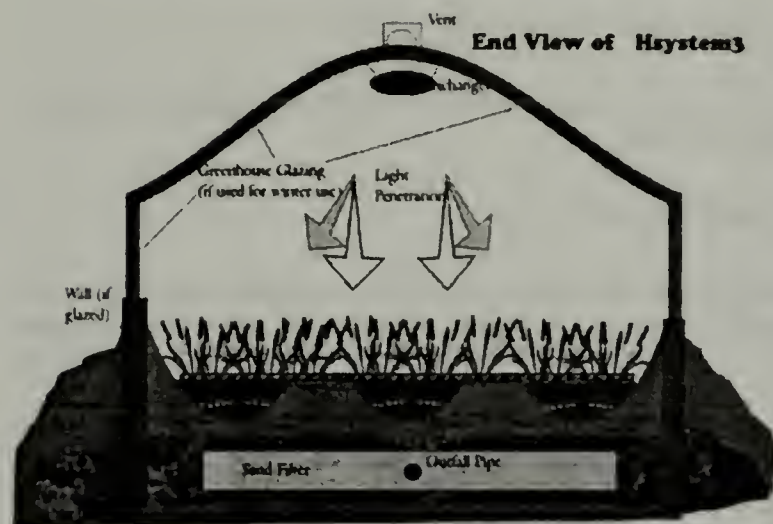
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It should be known that BioFence is the product of choice of five of the six New England states. The missing sixth state? – Massachusetts, the home of BioFence, produced in Lakeville, MA. BioFence was successfully used on the MBTA projects – Braintree to Plymouth rail construction by J.F. White, Framingham to Worcester by Middlesex Corp., and other state –related agencies like the MWRA, Massport, the MDC.

BioFence is proven as the 1999 EPA Environmental Technology Award Winner to save \$11,000 per mile for erosion control over the old 1940/50s technology of environmentally damaging hay bales and black plastic. Yet, upon a five year attempt to have Massachusetts Highway Department to approve BioFence as an approved substitute for hay bales and black plastic; ERC received comments like + *“it’s not in the highway manual”, or “the federal manual says to use plastic”, or “we are under-funded to conduct any new product testing”* We even worked diligently to have the product mandatory specified for the Fall River Brightman Street Bridge Reconstruction Project by the state-designated architect and listed in the project specs under the Mass Highway bid process, only to have the contractor break the spec. Upon request to Mass Highway to enforce the approved product list, only a shrug of the shoulders and oh, well - things happen, was received.

After five years, from 1995-2000, ERC gave up. We sell BioFence in Massachusetts to private developers only, to utility contractors, to local highway departments. We have stopped trying to use it on state projects where \$11,000 per mile of state savings could have been gained, instead concentrating our marketing efforts in other non-state locales where the advantages of the product are recognized and the use encouraged. Massachusetts did indeed encourage the export of a product, just not quite in the way that would have meant cost savings to the Commonwealth and tax revenue for the state.

Recognition of new technologies, especially those lauded elsewhere, is one way Massachusetts could aid the science and technology industries.



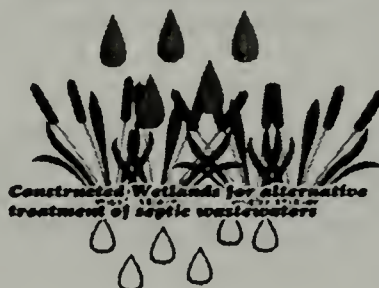
Science and Technology as an Economic Engine for Massachusetts' Future

Roadblocks and Stumbling Blocks Sample Case'– Detriments by Bureaucracy

Let's take a look at another type of roadblock – governmental ignorance

CASE STUDY #3 – by Mark A. Howland

Examining Solutions



Constructed wetlands as a treatment technology for wastewater is effective in treating the effluent wastes from on-site generation. It is one of the newest methods that provide an alternative to conventional treatment. An attractive feature of this technology is that they closely mimic the ability of natural wetlands to treat contaminated wastewaters.

Available from ERC, Hsystem constructed wetlands have advantages when used in lieu of conventional treatments.

- * The higher effectiveness in removing pollutants delivers measurably higher water quality to receiving waterbodies and groundwater.
- * The use of constructed wetlands can reduce or even eliminate the size of leaching fields needed for final disposal of wastewaters.
- * The use of constructed wetlands also remove heavy metals, hydrocarbons, and other toxins that conventional treatment cannot assimilate.
- * Conventional treatment depends on greywater's supposed inherent lower loading of BOD5 and suspended solids. However, in many cases, the levels of suspended solids and BOD5 can be found to be as high in greywater as in blackwater.
- * Constructed wetlands are more effective in treating greywater because greywater depends on its ease of microorganism access to organic matter. The use of constructed wetlands accelerates and enhances the biological decomposition process by the delivery of oxygen via the roots to the region of treatment.
- * Even properly constructed conventional treatments do not effectively remove nitrates and phosphorus. These pollutants are severely degrading to surface waters (ponds, creeks, lakes, etc....) as they generate eutrophication. Constructed wetlands through several chemical processes convert these substances to harmless components which can be assimilated into the receiving waters without environmental damage.

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Call the experts to assist in designing your wastewater treatment needs.

Specializing in agricultural manure runoff solutions, ERC offers the only product that meets regulatory requirements, and generates a profit too !

Design Parameters - Hsystem

The Hsystem is designed to have a useful, mainly maintenance-free life of 20 years or greater. Structural components of clay, plastic, wetlands vegetation, and other materials have proven life spans, and the vegetation has been picked to be regenerative and productive.

The Hsystem is designed to be placed into a plastic greenhouse if intended for winter use. The greenhouse will be lower wall based with cinder block coated with bonding agents. This waterproofs the foundation and provides the ability to bring up the ground level of the soil inside the unit to provide the necessary heights for gravity feeds of the system.

At the natural soil level, the settling pit for the introduction of the wastewater, and the sand filter bed for the collection of the cleansed waters will be set. After they are set in place, river bank clay will be used to seal their placement and to build up the ground height inside the greenhouse to a point where the gravel bed bottom is above the top of the sand bed filter.

The manure pit and the waste byproducts collection pits will be so positioned so that the liquid wastewater will flow over the rim edges of the pit and allow a drop of at least two feet into the initial inflow settling tank. This aerates the wastewater and allows a more productive update by the plants. Again the inflow settling tanks allows deposits of solids. These two areas (manure/waste pits and inflow settling tank) are often the only areas in need of regular inspection and clean-out of accumulated solids.

Berms of clay coated with CETCO ClayMax II liners will be formed to house wetland plant troughs. At the base of those troughs, a small organic layer will be placed of humus soils or crushed coco shells. Above that humus, washed gravel of two sizes ranging from 1" to 3" will be placed to a depth not to exceed 2' but recommended at 18" separated with a layer of crushed oyster shells. Suspended above that gravel in GeoGrid plant trays filled with BioMatrix™ soil substrate, plants will be introduced of the following types:

1. Graceful Cattails of a mix of *Typha angustifolia* and *Typha latifolia*. Graceful cattails achieve shorter height than the common cattails and have a more active root zone. They are noted pollutant removers and have a high oxygen generation to the root zone.
2. Arrow Arum (pelantandra) is a dense, low ground cover of hydrophilic nature. It develops a dense root mat which accelerates in areas where nutrient levels are high. It is prolific and can tolerate temperature reductions down to 45 degrees before lowering its productivity rates.
3. Additional plants will be utilized including other arums and arrowheads which are effective heavy metals and toxins removals. *Scirpus americanus* (rush) will also be planted which has effective ammonia removal and storage activity. It is also a species which is tolerant of varying nutrient levels, and survives a wide range of growth conditions and climate changes before lowering productivity.

It is intended that one trough be used for the waste runoff from agricultural operations. High in fats, this wastewater will require a greater concentration of the arums and saggitaria - excellent oil and grease removers in stormwater runoff, and equally effective for this type of wastewater. Thus plant mixes may vary within the structure.

At the discharge end of the troughs, a perforated collection drain of 2" PVC will be placed just above the organic layer and pitch to drain into the sand filter. It will be surrounded and within the gravel bed. This moves the waters which have passed over the surface layers of vascular plants into the gravel bed and oxygen rich anaerobic zone, and over the organic humus to be cleansed into the collection point which doubles as a non-biological sand bed filter. This sand bed filter will house the main outlet pipe which then passes the waters to the discharge point.

Final Stage - Vegetated Take-off Channel

The last stage for the "Hsystem" and the stripping of pollutants from wastewaters is the use of a vegetated takeoff channel. At this point, over 99% of the pollutants involved in septic treatment should have been stripped from the previous structures with the majority (90%) removed in the early stages during the wetlands ecosystem flush. Little to none of the pollutants make it past the third stage - the sand bed filter - and this vegetated take-off channel is designed as a "safety valve" type of structure to insure no pollutants pass to the groundwater or on-site soils.

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These takeoff channels are sized usually 5-8' wide by about 25' long, and the channels have 2' sides planted with rye grass and bird's foot trefoil. The base of the channel is contoured with a rough and "bumpy" configuration using 6" high, 1' wide clay berms. The entire channel is coated with clay-coated erosion blankets which forces the horizontal movement of waters over the berms for washing action.

Between the berms, capillary mats shaped like "pillows" are filled with peat. The matting is punched with holes to allow the introduction of plants. Experimentation elsewhere in Massachusetts has found that arrow arum, water clover, sedges, and various rushes work well in these structures. These plants are recognized pollution removers and will become quickly established once planted.

Discharge from the channels will be to vegetated buffer strip runoff zones to be indicated on designs by E.R.C.

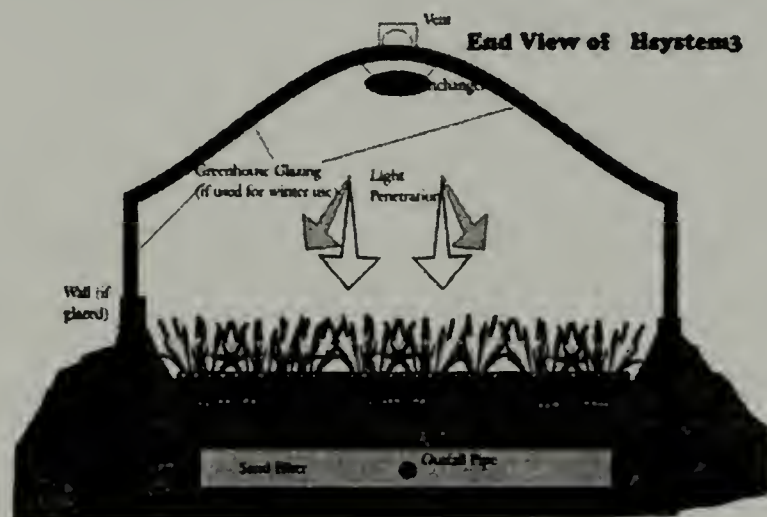
Extreme bacterial densities for cow/dairy farm operations is as follows: Fecal coliforms - 230,000 numbers per gram, Fecal streptococcus - 1,300,000 n/g

Removal efficiencies for constructed wetland systems (i.e. Hsystem2 -actual tested horse farm) units in col/100ml:

Fecal coliforms - IN 25,800 OUT 473 Efficiency 98.2%
Total coliforms - IN 1,150,000 OUT 24,000 Efficiency 97.9%
Fecal Streptococcus - IN 6,780 OUT 739 Efficiency 89.1%

Treatment efficiency was judged to average three days treatment time.

As a side component of a Hsystem, ERC has been experimenting with the Hsystem2 units (horse farm wastewaters) to incorporate a viable commercial crop with the Hsystem. Mushrooms, a relatively quick crop of 5-7 weeks generally likes a manure based wastewater for effective growth. ERC has used point discharge piping to direct Hsystem waters to mushroom growing trays and/or logs. Both the common button mushroom (grown in trays) and the oyster mushroom (grown on logs) have a high demand in the market commanding prices of \$0.70 to \$4 per pound. Often these units are placed between the Hsystem and the take-off channel, and are a low-cost unit to set up. As they require no other cultivation outside of the wastewater introduction, they assist in the payment of the costs of a Hsystem and provide an interesting economic side component.

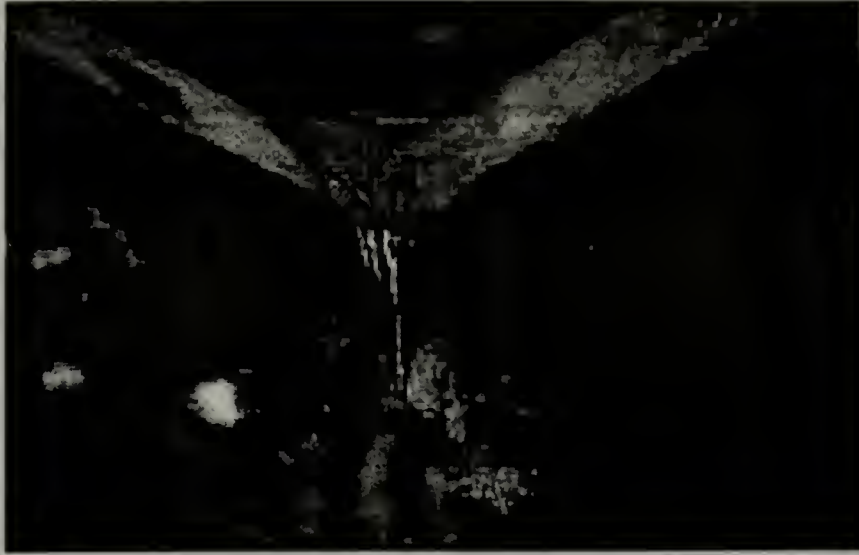


The federal government through the EPA and the USDA recognized The H System™ as an alternative way to treat farm runoff and waste product treatment. During the 1999 Massachusetts Trade Mission to Ireland, Environmental Research Corps, attempting to market BioFence and the stormwater swales, discovered that a little-utilized technology of theirs, the Hsystem™ had vast economic implications for export to Ireland. Today, ERC has an office in FitzWilliam Square in Dublin to begin the marketing of Hsystems™ to over 32,000 Irish dairy farms.

**Using Science and Technology to create
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But prior to that excursion, an attempt to market the units in Massachusetts had been made. ERC had tested and sold the units in Kentucky to thoroughbred horse farms, and to pig farmers in the Midwest. In the Southeastern Massachusetts local newspapers, a report of a dairy farmer allowing waste dairy milk and manure runoff to reach the Westport River was publicized. Fecal coliform counts were off the scale, the farmer resistant to environmental improvements, and local residents upset about the contamination of resources in their backyard.

ERC wanted to test the Hsystem™ designed at that time for horse farms, on a cow operation. The unit was offered to attempt to correct the problem at cost, with no design fees, no profit, and no extraneous cost. The federal government offered to pick up the physical cost of the unit for a trial basis. The State Department of Agriculture refused to allow a trial demonstration of a technology that had been proven in Kentucky, and now is being successfully marketed in Ireland, citing “*the situation is too volatile, and we rather let the controversy die down before any solutions are attempted.*” In ERC opinion, the comments by the State was rather than encourage and allow a trial for a new innovative technology, it was preferable to allow an environmental violation to continue, and the pollution to continue unabated. To this day, the situation continues, with the State’s environmental fine policy still not forcing the farmer to correct the situation, nor are the strict enforcement policies solving the pollution problem in the Westport River.



Science and Technology as an Economic Engine for Massachusetts' Future

Roadblocks and Stumbling Blocks

Sample Case – Regulatory Actions

Let's take a look at another type of roadblock – delays by regulatory actions and permit needs

CASE STUDY #4 – by Mark A. Howland

The following story was printed in Landscape Architect and Land and Water Magazine in 1998 in one issue, and a follow-up story by Landscape Architecture in 1999.

Environmental Dream Team Tackles Tough Environmental Issues

There comes a time when developmental needs and environmental issues meet head to head. Many of us have heard the old stories about how every developer thinks the best wetlands and forests are those under pavement, and how every person concerned about the environment gets labeled a "treehugger". But in the environmental field, there are still those projects where there are really no sides, and have tough environmental issues connected with the sites themselves.

Theodore "Ted" Parker merely wanted to develop his site. Located in Avon, Massachusetts, the Industrial Park site was already under a purchase and sale contract to L&C Flashing - a sign contractor who had the Mass Highway Dept. contract to make highway signs and needed the Avon site to expand its facilities from its Canton location and bring 90 new jobs to the Avon area.

Ted Parker figured he didn't have much of a problem. After all, on the site was only a small wet depression, one that he didn't realize might have wetland implications. He went through the usual steps, checking with the Avon conservation commission through a Request for Determination (RFD) procedure to see if the wet pocket required any permit filings. Given a negative determination, Parker assumed all was OK, and proceeded to fill the wet pocket to begin preparing the site for sale to the L&C Flashing group.

However, all wetland filings in Massachusetts, even the initial RFDs, are automatically reviewed by the state's Department of Environmental Protection (DEP). DEP disagreed with the town's conservation commission, feeling that the wet pocket might be hydrologically and vegetatively connected to adjacent Bordering Vegetated Wetlands belonging to an off-site stream on abutting properties. They filed a Stop Work order on Ted Parker to halt his filling activities.

Parker hired his surveyor - Curley & Hansen - Land Surveyors to address the problem. Baffled by the state's position that such a small wet pocket could be wetlands, C&H tried to settle the issues with DEP, but soon felt it was necessary to bring in their wetlands subcontractors - Environmental Research Corps - to appraise the issue.

ERC delineated the pocket and the abutting vegetated wetlands. They judged that there was no connection between the two areas, and documented the soil changes, the vegetation percentages, and the physical topography in coordination with Curley & Hansen. Assuming this would be the end of the issue, the materials were submitted to DEP to initiate the removal of the stop work order.

DEP didn't buy the argument that the two areas were isolated. ERC was a bit surprised to learn that their work was being questioned. After all, the lead contact for DEP, Gary McKuch, had worked with Mark Howland of ERC on several thorny problem sites in the past, and the two had high regard for each other's work. This time however, both parties had a different slant on the subject, and dug their heels in a bit.

Complicating the issue was the fact that spring 1997 storms were rolling in and the partially fill zones began eroding and depositing

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silt into the small wet pocket. Spring high groundwater elevations promoted the development of iron oxide in the abutting stream. DEP seized upon these events to try to prove a connection between the two areas, claiming that the fill compression was creating the iron oxide concentrations. They expanded the stop work order with a stronger enforcement order fining Parker for polluting wetlands with the iron oxide.

At ERC's recommendation, an environmental attorney was hired to attempt to resolve these escalating issues and forge a compromise. John Smolak of Peabody and Arnold law firm in Boston was retained. ERC produced a series of calculations proving that the wet pocket could not overtop the berm of land between it and the adjacent stream, thus dispelling a hydrological connection. DEP responded with a calculation that the pocket could overtop the berm in a storm event. Smolak finally got both sides to agree that an independent calculation would place the issue at rest. Michael Perrault of PMP Associates was retained as a civil engineer acceptable to DEP to calculate if there was a chance of the berm being over topped. With a complete study of the watershed, and an examination of microtopography, PMP Associates determined that the pocket would not overtopped and that all water would be retained in the wet pocket.

In Massachusetts, however, all non-state jurisdictional wetlands such as this wet pocket still might qualify as wetlands under the Clean Water Act of the federal government as administered by the Army Corps of Engineers. Given the now established hydrology, the presence of wetland vegetation, and an organic mat of soils; the ACOE's 3 parameter approach to classify wetlands was met, and the pocket now had some jurisdiction. Also, Massachusetts, Water Quality Certificate Program still gave DEP some administrative power to regulate the pollution potentials on any site developments. In order to settle the case, they insisted on a full mitigation scenario development addressing wetlands, wildlife and pollution issues before Parker could proceed with the development. They asked for 2:1 replication ratio if the pocket was to be filled, and that all development meet the new Massachusetts stormwater management policy requiring at least 80% TSS removal in stormwater facilities. They also wanted the iron oxide issue addressed.

Environmental Research Corps, Curley & Hansen, PMP Associates, DEP, and Peabody and Arnold teamed up to produce a full mitigation narrative. Erosion control was addressed by the placement of ERC's BioFence along all silt generating areas of the site's development to prevent silt entry to the wetlands and new wetlands facilities. A Howland Swale was added to provide a stormwater facility that met the TSS removal rates - Howland Swales, designed to replace traditional detention facilities, offer not only 98-99% TSS removal rates upon plant maturity, but also offer increased child safety protection, mosquito control, and ease of maintenance. American Excelsior Company's Curlex QuickGrass was added on exposed slopes down to the wetlands and drainage facilities for slope stabilization and an assist for eventual wildflower seed germination.

In order to fill the wet pocket to gain convenient parking and buildings areas, the site needed to meet DEP's required 2:1 wetlands replication ratio. A wetlands replication area about an acre in size was created in the rear of the site. Coupled with the constructed wetlands portion of the Howland Swale, almost an acre and a half of wetlands was created to replicate the wet pocket. After matting the sideslopes with AEC's regular Curlex, the replication areas was planted with trees and shrubs from Musser Forests, ferns and mosses from BioMass Farms, cattails, rushes, and hydric grasses from Wildlife Nurseries, and seed stock from Ion Exchange and Wildlife Nurseries. G. Lopes Construction of Taunton, MA was hired to do all the excavation and grading work, and ERC's sister firm - BioMass Farms - did the wetlands planting and erosion control work. BioSol fertilization was used for general soil treatment and ReForestation Technologies International's Planter's Pak tea bags were used for individual tree plantings. The site was designed so that all runoff on the site would go to the Howland Swales for silt removal and purification with the cleansed runoff feeding the replication area with excess waters (the replication area was excavated within the root saturation zone of the groundwater). After flowing through more wetlands plants in the replication area itself, the waters then would enter the region of the off-site stream insuring that it would not be starved for water and that it would be receiving clean water. Ironically, this design scenario finally established the hydrological connection DEP initially sought to prove, but also allowed for a connection that provided clean waters from a commercial development.

The remaining issue to address was the iron oxide pollution. ERC recommended and designed with DEP's input an iron oxide treatment center. The compressed peat soils generating the iron oxide were removed and groundwater collection trenches were put in before the wet pocket was filled. A groundwater sump pump provided by Stearns Irrigation collects the iron oxide laden groundwater and dumps the waters via an aeration orifice to a collection trough. Here the trough, lined with bentonite clay and planted with dense matting of wildflowers on the sideslopes, retains the water for a period for evaporation and settling. The iron oxide develops with the forced exposure to air, and the settling action allows the concentrations to accumulate in this area. Routine maintenance to clean out deposits simplifies the procedure. The overflow culvert in the trough leads down to a small-constructed wetlands to treat any waters that overflow the trough during storm events, and this double level of protection insures iron oxide deposits (ocher) removal before final discharge to the stream wetlands.

The environmental dream team, lead by Environmental Research Corps, Curley & Hansen Surveyors, PMP Associates, Peabody and Arnold law firm, and the Massachusetts Department of Environmental Protection; resolved their differences through scientific appraisal, compromise, and a high regard for wetlands mitigation. Ted Parker got to develop his site, and L&C Flashing bought the site and moved to the site in the late fall of 1997 bringing 90 new jobs to the region. A variety of erosion control and wetland planting techniques paved the way for allowing this site's utilization while at the same time safeguarding wetlands and water resources. An environmental dream team had done its job, taking a thorny environmental issue and resolving it to everyone's satisfaction.

The dream team has gone on to work on similar tough environmental issues. Invasive species treatment, wetland restoration, septic system mitigation, and erosion mitigation are just a few of the problems the team has addressed. The end result has been protection of wetlands; and the development of working partnerships between government, consultants, and developers to reach those goals.

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The Follow-up Story published in Landscape Architecture.....

When a Design Creates Success

In the January/February 1998 issue of Land and Water Magazine, a feature article appeared titled "Environmental Dream Team Tackles Tough Issues". In that article, Environmental Research Corps described how Theodore "Ted" Parker attempted to develop his site, became mired in a variety of environmental issues, and brought in an environmental dream team to assist him in resolving the issues and allowing his project to go forward. This project, not only being exemplified by the developer, the dream team, and the regulators as an example project that meets all parties' interests; was one of the L&W stories that attracted broad interest as evident by the inquiry calls ERC received. Not only buoyed by this interest, this project is unique due to the variety of erosion control products, regulatory interest, stormwater controls, and environmental factors brought to fruition in this project. ERC has felt that it is our obligation to continue to document this project that has brought 94 new jobs to a township, maintaining at the same time strict environmental controls. As a picture is worth a thousand words, the following photo-essay documents our follow-up story.



As mentioned in the previous story, the site is now owned by L&C Flashing Barricades, Inc. - a prime contractor for the Massachusetts Highway Department. Oreste "Rusty" DiMartino owns the firm, and was both tolerant and patient for the delays created by the environmental needs the project entailed. He wanted to bring over 75 jobs to the South Shore of Massachusetts area, and succeeded by having over 94 employees at this new facility less than one year later. L&C creates highway signage, both the overhead highway markers so common to a traveler showing an exit, but also the flashers and construction signage common to highway work. But even Rusty was surprised at the final results of the environmental design that allow his building project to go forward.

Key items for the project to go forward were 1/stormwater mitigation, 2/wetlands replication, and 3/iron oxide treatment. The EPA 1998 Environmental Technology Innovator Award winner Howland Swale™ was used to address stormwater management. As cited by the EPA and others, this stormwater technology, patented and released to the market in 1993 after 15 years of testing, has proved its worth in this project. In Massachusetts, the state Department of Environmental Protection (DEP) mandates a minimum of 80% TSS (total suspended solids) removal in all new projects that drain to wetland areas. The Howland Swale has been tested in over 776 installations as of June of 1998, and demonstrates a low of 83% TSS removal, with documented highs of 100% in over 25% of its installations.

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On June 16th, 1998, Massachusetts experienced between 5 and 10 inches of rain in the Greater Boston region. L&C's site, located in Avon, got exactly 7.0 inches in 24 hours - a famous 100 year storm event! The photo on the right is taken near the same location as the Jan/Feb L&W issue photo in the "Dream Team" article. Here, the Curlex erosion control blankets have performed as advertised, and in a community reeling from storm events, these photos taken 2 days after the storm show that L&C had no concerns about slope erosion due to the blankets. Likewise, the Howland Swale demonstrated that Rusty had nothing to worry about with stormwater management either. This photo shows the swale flooding remaining after the storm event.

As can be seen, this photo at the edge of the slope leading down into the swale's siltation trap™ shows the silt-laden and clouded waters in the forepart of the swale. The Howland Swale works with three major sections - the siltation trap™, the pre-treatment marsh™, and the vegetated adjustment chamber™. The Howland Swale's 1998 Technology Award reads in part - "in recognition for the Howland Swale - an innovative approach to stormwater management and water treatment that utilizes both engineering and biological control processes. Your ingenuity and vision will help protect our Nation's water resources and the environment for future generations."



This stormwater unit differs from its competitors in that a well-thought out "soft" bio-engineered process was developed to compete or replace common "hard" civil engineered designed structures. As can be seen here, the Howland Swale begins its stormwater runoff cleansing while still providing environmental enhancements such as wildlife habitat.

As the swale begins to clean the runoff, wildlife continues to enjoy the habitat. The siltation trap™ is designed to remove common "street sweepings" of large sediment particles such as sands and gravels, and also to attract via colloid action to varying stone sizes in the trap, the initial large particles suspended in the flow.

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Upon leaving the siltation trap, the flow is noticeably cleaner. Use of a TSS detection meter indicates that suspended solids have already been reduced by over 70% after passage through the silt trap.



The cleansing process continues by passage into the Howland Swale's pre-treatment marsh™. Here, a meandering path, both intentionally developed by the grading in the swale and also by nature's actions, passes the storm's runoff water over and through the vegetation and roots of selected wetland species picked to remove pollutants such as oils and greases, heavy metals, septic pollutants, etc.....

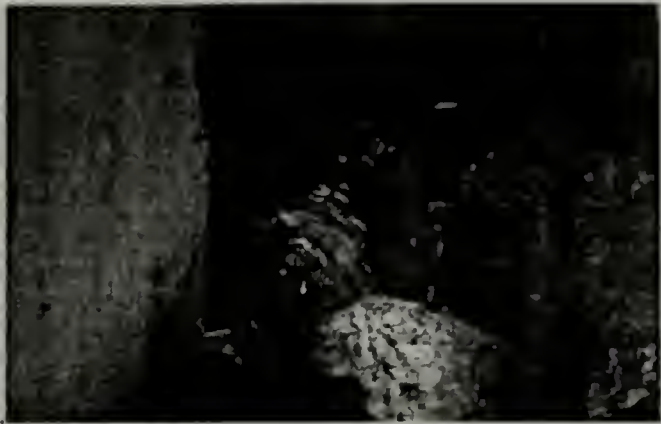
The Howland Swale here goes beyond Massachusetts' Stormwater Regulations calling for only TSS reduction rates. L&C Flashing, while an environmentally conscious company, still remains a commercial site, and pollutants unsuspected by the site owner can still be generated on the paved surfaces, and thus enter the stormwater mitigation structures via the catch basin once storm events begin.



So beyond the TSS removal, as evident by the noticeable reduction immediately after the 100 year storm event as the flow through the swale approach the control structure in this photo, the Howland Swale is also cleaning out other pollutants besides silt and sediment.

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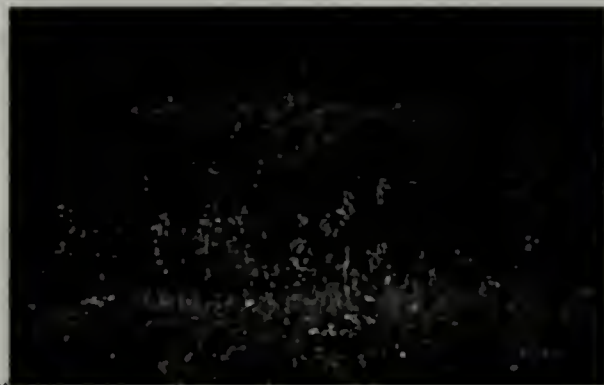
At this point, in an immature swale, the TSS removal rate averages about 85%. But, as the swale develops in its first year period, as is the case with the L&C site, levels of 95-98% TSS removal can be expected. Of course, the swale also addresses pollutants beyond those found in suspended solids due to its design. This rectangular weir shown in the above photo, also allows the Howland Swale to not only treat the "first flush" of stormwater runoff, known to hold 90% of runoff pollutants, but also is designed to contain the 100 year storm event. Thus, not only is the first flush retained and treated, but the entire regime of the storm event up to the 100 year storm is treated.

As the discharge out of the major portions of the Howland Swale show, this flow approaches drinking water standards. In fact, this swale, two days after a Northeast major storm event, showed 99-100% TSS removal. As well, as whole range of other pollutants were tested for and failed to show up on the testing regime.

So, the Howland Swale has demonstrated that not only it can remove sediment, but pollutants as well. The regulators as well as the developer will now enjoy cleaner waters.

But it is not just the people involved in this project that will enjoy cleaner waters. As may be recalled in the previous article, a dispute over jurisdictional wetlands resulted in the need to create over 1 acre of new wetlands in a "replicated" area to allow some of the disputed wetlands to be filled in order to allow L&C to develop the site and create a building envelope sized sufficiently to bring in 90 new jobs to the region.

Entering the replication area out of the Howland Swale, the new wetlands now enjoy clean water free of silt and sediment to develop the wetlands growth. In replication, waters free of silt are crucial as silt blocks root development, and prevents both root growth and normal plant development.



This clean water, along with the wildflower buffer zones enhancements ERC planted and seeded; allow the replication area to begin an active development as an active wetlands and wildlife habitat zone after 10 short months of existence.

The Howland Swale, the replication area, as well as an iron oxide treatment center all exist as perimeter borders to the overall site development for L&C Flashing. Though most of the neighboring properties are commercial, some are residential, and the aesthetic development of the side slopes stabilized with American Excelsior Co.'s Curlex erosion control blankets, and the subsequent seeding of the buffer zones with seeds from Wildlife Nurseries and Johnny Wildseed Farms all contribute to harmony with abutting properties.

Thus, the final desire of Massachusetts DEP, and all environmentalists everywhere resulted on this site. The final discharge, passing off pavement of a commercial site and laden with silt, sediment, and common pollutants, passed through a Howland Swale stormwater management unit for cleansing. Continuing through a replication area, the flow now enters the natural off-site brook. This brook now receives cleansed and purified waters, addressing both the state's regulations, as well as the environmental conscience of all concerned citizens.

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It is worth telling you about the iron oxide treatment center placed on this site as well. The ocher developed after the found filled wetlands compressing the soils had influenced the brook off-site with bright red-orange colors and high iron oxide concentrations. ERC's design accommodated a desire to reduce this low impact pollutant. A series of groundwater pumping and settling ponds resulted in an higher than expected result - total ocher trapping.



The off-site brook, once bright orange in spring and fall, now enjoys normal coloring as seen in the photo to the right. Beyond the cleansed waters fed into it from the Howland Swale and the replication area, this brook still enjoys the watershed input it had before, but now receives cleansed and iron-oxide freed waters.

Beyond Ted Parker, who got to develop and sell his site to L&C Flashing, or L&C who not only developed 94 new jobs but got an environmentally correct site; there was still one more party that has to be pleased. The few non-commercial neighbors to the property got more than they expected.

Beyond slopes that usually erode away, but were retained by excelsior blankets, or buffers that normally would have been seeded with grasses from hydroseeding or hand-casting; these neighbors got to enjoy wildflower meadows designed by Wildlife Nurseries, Ion Exchange, and Johnny Wildseed Farms. The views out their back windows to L&C Flashing's site did not bring the usual concrete drainage structures, the grassed slopes. Instead, aesthetics and neighbor concerns were considered a vital part of the "dream team's" overall design plan, and the results show.



The "Dream Team" planned for results, but did not expect overall success. Fortunately, this was one project where the results exceeded the goals; and it was obvious to see that a good design created an overwhelming success.

What is the point here?

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The regulatory environment in Massachusetts creates delays. A case in point in another project ERC has been involved with was located off Route 139 in Randolph. There, a firm wanted to locate across from the Reebok complex, and bring 60 new jobs to the locale. Permitting for the facility took 11 months, 2 months of that alone to get a “DEP file number” – a number from the state agency that recognizes a permit application has been filed and received by the state. Before local boards can conduct public hearings or take action, the file number must be issued, a purely administrative action that can take up to two months. But this firm patiently waited through all the steps and won regulatory approval 11 months later.

Just prior to starting construction, it was discovered that once permit had been overlooked – curb cut into the granite curbs of Route 139. Six months later, after seeking permission from the highway authorities for the curb cut, and receiving no response, the developer abandoned the project and brought the 60 new jobs to a facility in Connecticut where the permits for construction were gained in five weeks.



Science and Technology as
an Economic Engine for
Massachusetts' Future

**Quality of Life - Economic
Vitality...**

A brief discussion of another
factor for using science and
technology as an economic
engine for our future –
avoiding mistakes of our past.

Environmental Injustice is a new term for our region. In the last great economic development of Massachusetts, the industrial boom, factories, warehouses, manufacturing plants soon populated our countryside, creating the jobs for the veterans returning from WWII, increasing the productivity of our nation, and providing for our quality of life by ensuring that there was *"a chicken in every pot"*.

But there was a price to pay for that economic development. Today, we call those factories *"brownfields"*, and the sites *"polluted"*.

There was not the overall awareness of the impact of economic development that is present today. One of the advantages to the science and technological innovations of the industries today is the environmental awareness. No longer does this state fail to recognize the location of polluting industries in minority or economically disadvantaged regions or communities. Community fit, neighborhood safeguards, property protection, and environmental awareness are and should remain to be part of the overall economic development plan for the emergence of science and technology as an economic engine.

There should be a link between the technologies that clean pollution, that use "green" manufacturing techniques that can utilize and train workforces in disadvantaged areas. Not only can we locate these green technologies in suburbs and rural environments where they have little impact beyond job creation; but also efforts can be made to reverse the effects of environmental injustice. Brownfields such as the 1 million square feet of factory space that exists in New Bedford at the Chamberlain Mills – home of most of the manufacturing of munitions and ammunition in World War II – that today is contaminated with arsenic, mercury, cadmium, lead, and other compounds left over from making bullets; can have the government seek out and secure the technologies not only to correct the problem, but to utilize the site in a green fashion.

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Recommendations to the Commonwealth to Channel Massachusetts' future to a new, innovative direction...

Recognizing the past, creating a tie to the future...

This is not the time to throw everything in the past away, and start over. Tremendous strides have been made by the

Commonwealth to recognize science and technology as valued economic partners.

We already have many of the pieces for success in place – industry trade group organizations, university support, talented workforce, creative scientific minds....

The state has many organizations that can help create viable futures for sci-tech firms. The Mass Office of Business Development, the International Trade Assistance Center in Fall River, the University of Massachusetts Research Centers are just a few places one can think of that give invaluable aid. But there is a need for promotion, for cataloging the services, for consolidation and ease of use and entry to these services.

The first viable step that can be realized by the Science and Technology Committee is to conduct a complete cataloging of resources – beginning in the public sector, and with a look at the academia support. Continuing into an appraisal of the private sector, recognition of the types, varieties and depth of science-tech, high-tech, and eco-tech industries will go far in recognizing our past, understanding where we are, and creating a tie to the future.

A simple step can be to ask each State Representative to inventory their community, or to ask local Selectmen or City Leaders to provide the names and types of industries in their communities. In this manner, we understand what we have.

An example for my community of Freetown from an unofficial town web page found at www.homestead.com/chrisfile - that as a category called *Freetown Businesses*, is as follows:

FREETOWN BUSINESSES

A.A. Will Materials
Acushnet Tool Co
Affair with Flowers

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Anderson Cushing Insurance
Apakart.com
ArmorThane of New England
Assonet Art
Assonet River Design Group
B-Sharp Entertainment DJ
Biofence - Biomass Farms
Brightman Lumber Co
Commonwealth Police Service
Compass Bank
Computer Network Services
Concrete Solutions
David's Restaurant
D.E.L.S. Manufacturing
Dr Music DJ
Dunkin' Donuts
Dutch Country Kitchens
E.M.I. Electric
Environmental Research Corps
F.J. Torres Insurance
Family Service Assn of Greater F.R.
Farm Family Insurance
Fleet Bank
Garden Gate Bed and Breakfast
Global Choice Showcase
Heat Transfer Products
Homemade Gourmet
Honey Dew Donuts
HTM Limited
Independence Harbor
International Specialty Products
Jake Fagan Construction
Mass Highway
Mobil Gas
Mrcody's Web Publishing
Nephew's Restaurant
Pine Grove Plastics
Professional Landscaping
Rezendes Real Estate
Robert St. Amand Aluminum
Saxton Consulting
Schiff Karate Center
Serve New England
Slab Bridge Country Crafts
Stafford Insurance
Stop and Shop
Steppin' Up Dog Training
Stoney Acres Farm

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Subway
Texaco Gas
The PC-DOC
Ticket Pile
Tim the Magician
U.S. Post Office
Veterans of Foreign Wars
Webshowplace
Weyerhaeuser
Whitney Academy
Woodland Animal Clinic

There are at least a dozen manufacturers, firms, companies, innovators, and talented business people listed here. If every one of the 351 towns and cities of our Commonwealth took the time to publicize the science and technology links found within their own communities; and if the state recognize the status of the industry as related to science and technology that can be found now in the Commonwealth – an important first step to creating a tie to the future.

It is important to state that the past practice with the Commonwealth with firms that develop innovation, conduct research and development, attempt to bring current science into the future is spotty at best. Massachusetts runs a program called STEP for example that is suppose to evaluate technologies, and assist in product verification. It can be wondered how many firms are reluctant to reveal details about innovative technologies given the loss of control over product identity in entering a state program, or wonder at the insistence of the state to know financial details or employee counts, and marvel at the state employees who insist on managing the technology with no background in the science, if an innovative sci-tech firm gets involved with the program. Facilitators, not managers, are needed to bring science and technology forward.

It is our heritage to be leaders; it is our past to be innovators; it will be our future to be prime movers for the future.

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Recommendations to the
Commonwealth to
Channel Massachusetts'
future to a new,
innovative direction...

**Selected Concepts that can
create an Economic
Future...**

Every attempt to bring
our lives, our economy,
our future forward

involves ideas, it involves opinions, it involves concepts, and sometimes, it involves just throwing some ideas out.

This section of this report is thus... throwing a few ideas out.... Ideas from abroad, ideas from locally, ideas from the Nation....

There is no particular sense, rhythm, or reason to the ideas laid out and presented here. They are fuel for thought, concepts to research, changes to consider...

- a brochure from the Germany Trade Mission as Rep. Mark Howland met with German firms on environmental technologies reads as follows with its subtitle headings:

BERLIN – home to environmental technology

Berlin-Brandenburg: Investments in environmental protection and promotion of modern environmental technology

Cultural Perspective and Industry: A challenge for environmental technology in Berlin-Brandenburg

Worldwide Growth Industries: Development and production of Environmental products and services

Berlin-Brandenburg: A market with high standards and growing demand estimated at \$37 Billion (US)

Made in Berlin: Innovative Environmental Technology Products

Excellent Networks: Research, Development, and Applications

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Present and Future: Environmentally-Compatible Energy for Berlin-Brandenburg

Enormous Sales Potential: Future Markets in Eastern, Central, and Western Europe.

Ambitious Projects: Environmental Protection in Berlin-Brandenburg

New Solutions: Waste Management with integrated technological concepts

Major Investments: Sustainable Water Supply, and clean-up programs

A Breathe of Fresh Aire: Preserving the climate with the Berlin Clean Energy Concept

Clearly to see, we are not alone in innovation. Let's run down to the meat of this brochure... if you fit one of these categories, and I can think of dozens of Massachusetts firms that do... then this is the offer to settle in the Berlin-Brandenburg region:

- subsidies up to 35% for creating new businesses (up to 50% if firm meets small business classification), expanding operations, surveying or purchasing new equipment.
- investment bonus of up to 5% (10% for the small business classification) for the purchase of new movable/fixed assets, machinery, or equipment.
- special capital allowance on purchases up to 50%
- loans to supplement investor equity capital
- investment loans for products involving public programs, as much as 50%
- indemnity bonds for up to 80% on investment loans, and even in cases, for operating expenses.
- State support for research and development
- Buy-back program of capital shares from investment firms

Are some of these programs here?... sure.... we have the MOBD's *Massachusetts Business Advantage Program* for example. But, again, the focus is managing your business, not facilitating it.

It should be noted that Germany, along with other Eastern European countries offer other major labor-related programs. Items like full reimbursement for training programs for three months and 50% of labor costs for one year of a

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technologically-advanced job, special programs for hiring women and unemployed youth, and even social adaptability costs for employee adjustment to new technology.

Let's take a brief look at Northern Ireland's promotional brochure if one locates to war-torn Belfast in Northern Ireland....

BELFAST CITY– ... AN OPPORTUNITY FOR YOU!

City of Innovation

City of Learning

City of Enterprise

City of Friends

City of Culture

The approach is different here, These are not the money incentives as seen in Germany. These are the appeal to the heart. It is akin to the section I mentioned earlier in requesting we inventory our assets, and brag about the firms and companies we already have. In Belfast, the economic statement is *"We built the Titanic, when it left here, it was fine..."*

Belfast offers incentives such as these:

- a chance to link civic leadership with business acumen to create a dynamic force for economic growth.
- an inventory of Belfast's ability to deliver the information private sectors seek.
- hard information on the city, property costs, labor markets, and skill bases.
- introductions to business leaders
- internaries for fact-finding mission to the province.
- welcome and assimilation programs

But Belfast states – *"the message is clear – Investment Belfast"*

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These are the two extremes of overseas approaches to enticing science and technology business investment. Massachusetts has its own programs in place, let's look a bit further at what is offered elsewhere...

QUEENSLAND, AUSTRALIA tells you to "*make the move*" with your high-tech business. They entice you with complete details of *Research Institutes and Government Resources, Universities, Cooperative Research Centres, Health and Medical Assets, Science and Technological Production Companies, Biodiversity, and* much more, then hit you with why you should consider investing in Queensland.

Beyond the rhetoric -like *global links, the people, lowest taxes, political stability, globally traded services*, the nuts and bolts of investing in locating a firm in Australia's Queensland comes down to ***Investment Incentives***.

- state tax exemptions on science-related products
- relocation and training assistance
- concessions for location of regional or international headquarters location
- project and product facilitation
- encourage and tax breaks for foreign dollar investment in technologies

Somewhere between Berlin and Belfast is how this should be judged. Massachusetts needs to regard the various incentive options offered, evaluate the non-financial assets this Commonwealth offers, and judge the level of commitment needed to compete with these various other regions of the world competing against us for the brightest and the best of our future...

It could be continued to use other examples – Melbourne, Australia citing we are a city that understands business as their prime calling card for example; Nuremberg, Germany using the "*location, location, location*" theme for attracting businesses to Central Europe, to France citing "*Long-Term Experience in research and training – France, High-Tech and Savoir-Faire*"

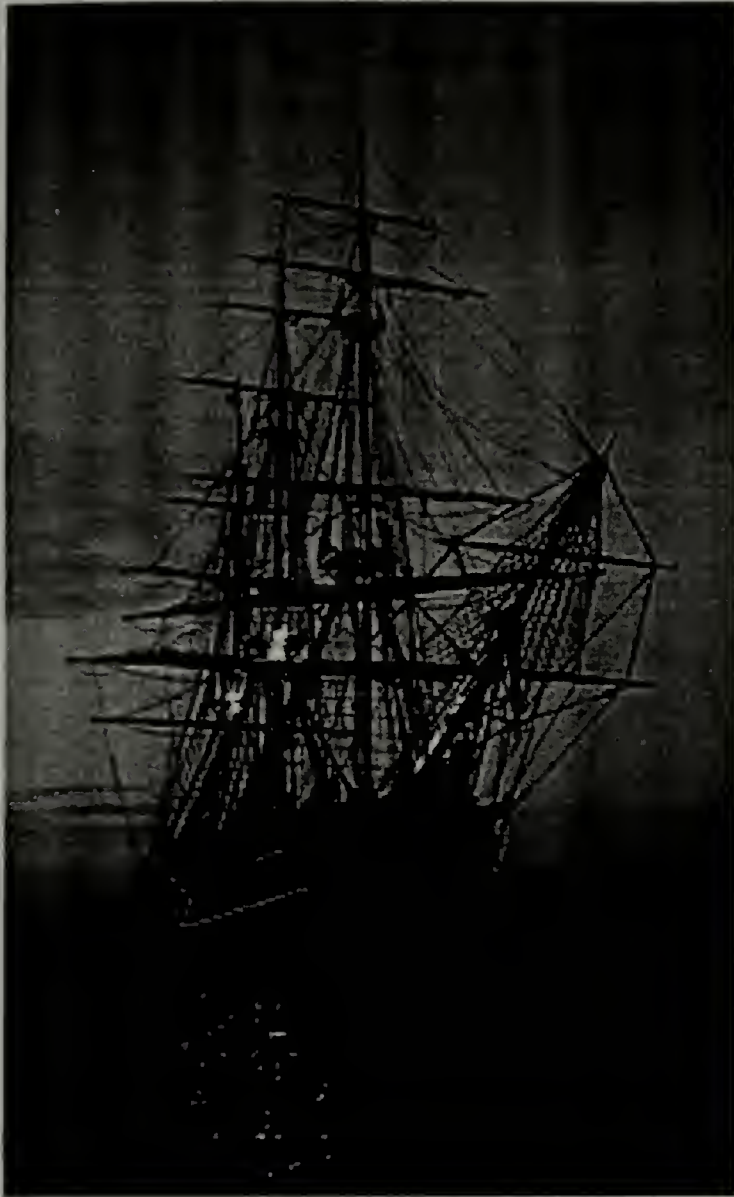
But we also have national competitors – in the field of science and technology, Connecticut, California, and the Carolinas spring to mind...

California for example offers a 7 percent job creation tax credit and a 6% manufacturing credit while Massachusetts offer no job creation credit and a temporary 3% tax credit (normally 1%) on the purchase of manufacturing equipment. Connecticut offers 10+ years of free utility costs for re-located

manufacturers, for example while North Carolina offers up to 75% percent of relocation costs up to \$250,000.

It is not needed to detail here the cost and incentives packages offered elsewhere in the nation. The information is readily available on the web or via a quick phone call for any firm with science, innovation, and technology in its title or product line.

Massachusetts needs to evaluate the value placed on science and technologies industries around the nation, and indeed, around the world; and determine which packages, with what flexibility, and with what cost can best allow us to remain the world leaders in innovation and technology.



Recommendations to the
Commonwealth to Channel
Massachusetts' future to a new,
innovative direction...

**Proposed Legislation for viability and
action...**

This is just a short-term work group to bring a focus on Science and Technology serving as an Economic Engine for Massachusetts.

This presentation should only be the beginning to explore and recommend ways to help expand and diversify industries in Massachusetts and help lay a course for a new future for our technology-based industries.

Among these pages were comments, critiques, and ideas that addressed issues, problems, and solutions to go forward.

As legislators, it might be considered to regard the following:

- define the appropriate roles for government
- shift the focus from managers to facilitators
- promote technology-based development
- identify economic development opportunities for Massachusetts firms
- initiate a more pro-active approach toward the recognition of technologies
- honor innovation, patents, trademarks, and copyrights of Mass-based innovations
- combine and promote a synergy between economic mainstays in the state, our colleges and universities, our private and quasi-public research facilities, and enhance our marketing efforts based on those resources to advance technologically-based industries, facilities, and programs.
- provide challenging and rewarding opportunities for local graduates to enter the Massachusetts workforce, thus reducing brain-drain, and promoting a goal of enhancing the breathe and depth of our workforce.

**Using Science and Technology to create
An Economic Engine for the Commonwealth**

